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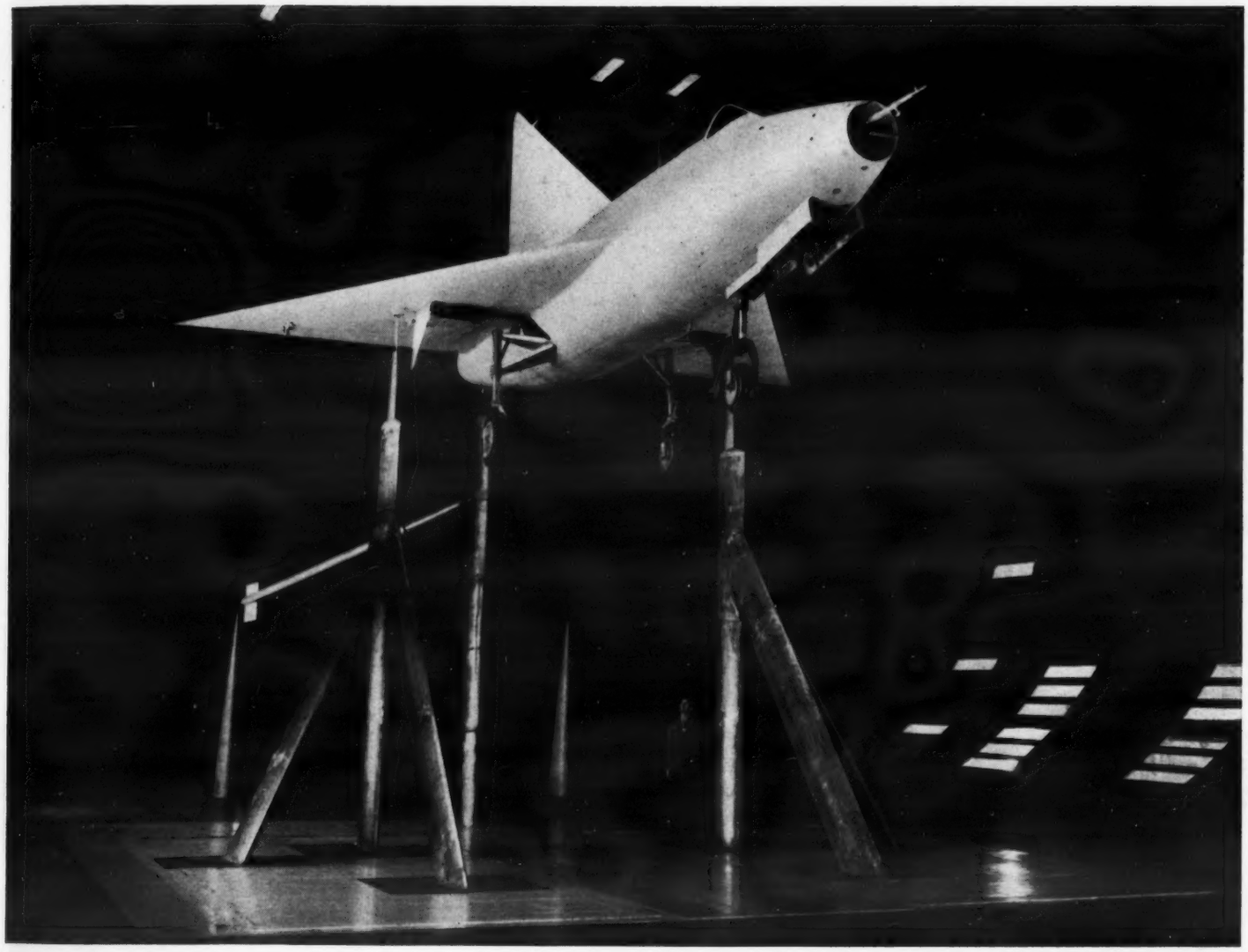

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IN THIS ISSUE

Outlook for 1953 – Supersonic Wing Shapes

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Index to Volume VIII – 1953

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General Subjects

No. 1. Outlook for 1953 — Supersonic Wing Shapes
No. 2. Turboprops
No. 3. The Aircraft Carrier ... Giant or Pigmy ?
No. 4. " Vertical Warfare "
No. 5. Flying Robots
No. 6. 20th Paris Aircraft Show
No. 7. In Europe's Laboratories
No. 8. Zürich's Air Station - Paris Panorama
No. 9. Background to Farnborough 1953
No. 10. Air Transport 1953
No. 11. Rockets for Peace and War
No. 12. 50 Years of Powered Flight

Index by Subjects :

Biographical - Historical

Europe laid the Foundations : 7, pp. 376-378
He floats through the air with the greatest of ease... : 9, pp. 522-523
Fifteen Years of T.C.A. Progress : 10, pp. 575-577
C.P.A.'s Ten Years of Service : 10, pp. 578-579
The Birth of Flying — W.C. de Houthulst : 12, pp. 692-693
Men Have Been Flying for Fifty Years — Ch. Dollfus : 12, pp. 694-703
An American's Comments on the Wright Brothers' Anniversary — W. H. Wager : 12, pp. 704-705
Faster and Higher : 12, pp. 706-707
Thirty-three Years of Aircraft Manufacture — F.W. Conant : 12, pp. 708-709
From Glue-Pot to Hall of Giants — H. L. Hibbard : 12, pp. 709-710
Grandfather Taught us How — G. Voisin : 12, pp. 711-713
A Test Pilot Reminisces — J. L. Parker : 12, pp. 713-715
1953 and On... — Sir Roy H. Dobson : 12, p. 716
Germany's Contribution to Aviation — W. Messerschmitt : 12, p. 717
Memories of a Designer — E. Heinkel : 12, p. 718

Air politics

The Economic and Physiological Limits to Air Power — P. M. Gallois : 1, pp. 15-18
A Japanese Come-Back ? : 1, pp. 36-39
German Aviation Awaits Ratification of German Treaties : 2, p. 92
Eisenhower Cabinet Promises Strong Air Power—Chris Roberts : 4, pp. 198-199
German Aviation on the Way : 5, pp. 250-251
Accent on Defence or Sound Economy : 7, pp. 404-406
Dr. Warner Sums Up : 8, pp. 406-407
Noises off : 8, p. 408
Progress Report on U.S. Air Power—Chris Roberts : 10, p. 594

International organizations

Will Montreal's " Aviation Building " Lose its Tenants ? : 1, pp. 43-44
I.A.T.A.'s New Members : 1, pp. 45-46
Business as Usual at ICAO : 6, p. 340
Dr. Warner Sums Up : 8, pp. 406-407
Prologue to I.A.T.A.'s Ninth Annual General Meeting : 10, pp. 563-564
I.A.T.A.'s Big " At Home " : 10, pp. 568-570
A.I.C.M.A.—Georges Héreil : 10, pp. 580-581

Aircraft

Commercial Aircraft

Connie Courts the Customer : 1, pp. 40-42
Turbine-Powered Commercial Aircraft—Louis Bréguet : 2, pp. 68-71
The Bristol *Britannia* : 2, pp. 78-80
The French Civil Aircraft Programme : 2, pp. 99-100
America and the Turboprop : 2, pp. 101-102
The British-American Jet Transport Controversy : 6, pp. 328-330
" Flying Palaces " : 9, pp. 514-517

Military Aircraft

The Delta—Shape of the Future : 1, pp. 29-31
Boeing Builds Swept-Wing Bombers—R. M. Robbins & W. H. Cook : 1, pp. 32-34
Dressing Fighters for Travel : 2, pp. 89-90
Little-Known Aircraft of World War II : 2, p. 91
Handley Page H. P. 80 : 2, pp. 102-103
Carrier-Based Aircraft : 3, pp. 130-133
Transport Glider Operations in World War II—E. Peter : 4, pp. 191-194
Target Aircraft : 5, pp. 244-248
Planes for Payload : 6, pp. 332-334
Britain's Air Power Today : 9, pp. 500-507

Design for Production—W. E. W. Petter : 9, pp. 531-534
AISA I-115 : 10, pp. 586-587
The Piloted Delta-Wing Interceptor—Alain Buret : 11, pp. 664-665 ; 12, pp. 725-727
The F-100 *Super Sabre* : 12, p. 727

Flying Boats

Assembling a Turboprop Giant : 2, pp. 84-85
Convair *Sea Dart* : 4, p. 211 ; 10, p. 591

Rotary-Wing Aircraft

Assault Transports and Helicopters : 4, pp. 186-190
Helicopters over New York : 4, pp. 200-203
Aboard the First International Helibus—Georges Février : 11, pp. 654-655

Aircraft carriers

The Aircraft Carrier—Giant or Pigmy : 3, p. 119
The Aircraft Carrier Today and Tomorrow—P. Barjot : 3, pp. 119-127
Steam Catapults for U.S. and Royal Navies : 3, p. 123
The " Canted " Deck : 3, p. 125
Today's Aircraft Carriers : 3, pp. 128-129
Is the Aircraft Carrier Doomed :—3, pp. 134-137
The U. S. Navy's " Forrestal "-Class Carriers : 3, p. 141
Ready to Sail—Scholer Bangs : 3, pp. 142-147
The Truth about " Mainbrace "—P. Barjot : 9, pp. 510-512

Power plants

Civil and Military Propeller Turbines : 2, pp. 72-76
Propellers for Gas Turbines : 2, p. 86
America and the Turboprop : 2, pp. 101-102
Miniature Jets for Peace and War : 4, pp. 204-205
Jet Propulsion—a Small Nation's Dilemma : 5, pp. 258-260
The SNECMA *Escopette* Pulse-Jet— J. Bertin, F. Paris, J. Le Foll : 6, pp. 343-347
Ramjets and the Work of René Leduc : 7, pp. 400-403

Technical and industrial

U. S. Aeronautics in 1953—Chris Roberts : 1, pp. 19-20
What's in a Shape ?—Straight, Swept or Delta ?—Scholer Bangs : 1, pp. 21-22
An Engineering Comparison Using Straight, Swept, and Delta Wings—K. E. Van Every : 1, pp. 23-27
Comments on " An Engineering Comparison Using Straight, Swept, and Delta Wings "—L. P. Greene : 1, pp. 27-29
The Delta—Shape of the Future : 1, pp. 29-31
Boeing Builds Swept-Wing Bombers—R. M. Robbins, W. M. Cook : 1, pp. 32-34
The Straight Wing—Aerodynamic Step-Child or Supersonic White Hope : 1, pp. 34-35
Subject : Turboprop Aircraft : 2, p. 67
Turbine-Powered Commercial Aircraft—Louis Bréguet : 2, pp. 68-71
Civil and Military Propeller Turbines : 2, pp. 72-76
Will the Propeller Turbine Oust the Piston Engine ?—A. Baltensweiler : 2, pp. 76-77
Airline Ops with Turbo-Props—E. L. Killip : 2, pp. 81-83
The French Civil Aircraft Programme : 2, pp. 99-100
Maintenance as Safety Factor—B. S. Shenstone : 3, pp. 148-149
Braking the Landing Run of Jet Aircraft by Thrust Deviation—K. Iserland : 3, pp. 151-154
Assault Transports and Helicopters : 4, pp. 186-190
Maintenance of Aircraft Electrical Equipment—J. H. M. Sykes : 4, pp. 209-211
Centre of Pressure Travel on a Supersonic Wing in the High Subsonic Range—H. R. Voellmy : 5, pp. 263-265
Materials for Rocket Combustion Chambers—H. G. Mebus : 5, pp. 266-267
Induction Generators for Guided Missiles—Elvin D. Lytle : 5, pp. 268-269
Le Bourget's New Control Tower : 6, p. 313
France's Aircraft Industry Comes of Age—P. M. Gallois : 6, pp. 314-316
France's Aircraft Industry—1953 : 6, pp. 317-323
The French Accessories and Equipment Industry : 6, p. 322
The British-American Jet Transport Controversy : 6, pp. 328-330
The SNECMA *Escopette* Pulse-Jet—J. Bertin, F. Paris, J. Le Foll : 6, pp. 343-347
Ramjets and the Work of René Leduc : 7, pp. 400-403
Technical Review of the Paris Air Show : 8, pp. 385-400
Why did the *Comet* crash ? : 8, pp. 411-412
Preview of the Turin Technical Exhibition : 9, pp. 518-519
Design for Production—W. E. W. Petter : 9, pp. 531-534
Collins' Integrated Flight System—Franz Baumgartner : 10, pp. 602-604
A few Comments on Rocketry—Th. von Karman : 11, pp. 628-629
America's Growing Rocket Industry—A. L. Antonio : 11, p. 630
American Rocket Missiles : 11, p. 630
Rocket Development in France : 11, pp. 636-637
The Control of Pilotless Aircraft—M. Gianoli : 11, pp. 638-640
Problems of Rocket Propulsion at the 4th International Astronautics Congress : 11, pp. 641-643
The Electronic-Optical Tracking System—G. Weber : 11, pp. 659-663
Launching System for Self-Propelled Missiles—Wolfgang Pilz : 11, pp. 663-664
The Piloted Delta-Wing Interceptor—Alain Buret : 11, pp. 664-665 ; 12, pp. 725-727
Thirty-three Years of Aircraft Manufacture—F. W. Conant : 12, pp. 708-709
From Glue-Pot to Hall of Giants—H. L. Hibbard : 12, pp. 709-710
Grandfather Taught us How—G. Voisin : 12, pp. 711-713
1953 and On...—Sir Roy H. Dobson : 12, p. 716
Germany's Contribution to Aviation :—W. Messerschmitt : 12, p. 717
Memories of a Designer :—E. Heinkel : 12, p. 718
The Weapons System—P. M. Gallois : 12, pp. 719-722

Research

What's it like at 100,000 feet : 4, p. 197
Europe's Scientists and Engineers Need Modern Equipment : 7, p. 375
Europe laid the Foundations : 7, pp. 376-378
New Tools for the Old World—P. M. Gallois : 7, pp. 379-381
Italy's Contribution to Aeronautical Research during the First Twenty Years of the Century—G. A. Crocco : 7, pp. 382-385
British Aeronautical Research and Development—H. M. Garner : 7, pp. 385-389
Aeronautical Research in France—Maurice Roy : 7, pp. 390-392
German Aeronautical Research Seeks New Roads—A. Betz : 7, pp. 393-394
A new Start for German Research : 7, p. 394
What the Smaller Nations are doing 7, pp. 395-399
Woomera breaks the News Barrier : 9, pp. 508-509

Guided missiles

" Fantastic Weapons " : 5, p. 231
Robots Join the Arsenal—P. M. Gallois : 5, pp. 231-237
Boeing Rockets over Alamogordo : 5, pp. 238-239
World Guided Missile Trends—M. M. Decker : 5, pp. 240-243
Chance Vought *Regulus* : 5, p. 266
Rockets for Peace and War : 11, p. 627
A few Comments on Rocketry—Th. von Karman : 11, pp. 628-629
America's Growing Rocket Industry—A. L. Antonio : 11, p. 630
The *Aerobee* Research Rocket : 11, p. 631
Within the Shadow of Russian Missiles—K. W. Gatland : 11, pp. 632-634
British Guided Missiles : 11, p. 635
Rocket Development in France : 11, pp. 636-637
Problems of Rocket Propulsion at the 4th International Astronautics Congress : 11, pp. 641-643

Navigation - Radar

Standardization of Approach Procedures for Modern Radio Aids—P. Carour : 6, pp. 348-349 ; 7, pp. 409-413
New Electronic Aids for Aviation : 9, pp. 534-538
Collins' Integrated Flight System—Franz Baumgartner : 10, pp. 602-604

Parachutes

Parachutes as Weapons : 4, p. 176
" Paramedics " and " Paranurses " : 4, p. 195
Pioneer's New Personnel Parachute : 5, p. 255
He floats through the Air with the greatest of Ease... : 9, pp. 522-523

Air transportation

The Future of Civil Air Transport—Henri Ziegler : 1, pp. 12-14
A Japanese Come-back : 1, pp. 36-39
Civil and Military Propeller Turbines : 2, pp. 72-76
Airline Ops with Turbo-Props—E. L. Killip : 2, pp. 81-83
What the Passenger Doesn't See : 2, pp. 87-89
German Aviation Awaits Ratification of German Treaties : 2, p. 92

Helicopters over New York : 4, pp. 200-203
German Aviation on the Way : 5, pp. 250-251
The Impact of Cargo on Air Transport Planning : 5, pp. 252-255
The British-American Jet Transport Controversy : 6, pp. 328-330
The Development of International Performance Standards for Commercial Aircraft—A. Münch : 8, pp. 412-415
T.A.P. Becomes a Private Airline : 9, p. 520
Aviation Trends in " Quadrizonia... " : 9, p. 521
Interim Report on an Experiment—G. Pilé : 9, pp. 524-526
International Air Transport—Prospect and Retrospect—Sir W. P. Hildred : 10, pp. 565-568
Pillars of World Air Transport : 10, pp. 571-574
Fifteen Years of T.C.A. Progress : 10, pp. 575-577
C.P.A.'s Ten Years of Service : 10, pp. 578-579
Aboard the First International Helibus—G. Février : 11, pp. 654-655
An American's Comments on the Wright Brothers' Anniversary : 12, pp. 704-705

Ground organization

Le Bourget's New Control Tower : 6, p. 313
United Air Lines' Airdock Project : 6, p. 339
Zürich's Flughof : 8, pp. 401-405
Switzerland's International Airports : 10, pp. 582-583
Città di Torino Airport—A. Peyron : 11, pp. 644-645

Service aviation

The Economic and Physiological Limits to Air Power—P. M. Gallois : 1, pp. 15-18
The Delta—Shape of the Future : 1, pp. 29-31
Civil and Military Propeller Turbines : 2, pp. 72-76
Air Transport is Vital in War—P. M. Gallois : 4, pp. 175-179
The Battle of Arnhem-Nijmegen—September 1944—A. D. W. Pickert : 4, pp. 179-183
" Soviet Paratroops over Western Europe... " : 4, pp. 184-185
Assault Transports and Helicopters : 4, pp. 186-190
Transport Glider Operations in World War II—Ernst Peter : 4, pp. 191-194
Target Aircraft : 5, pp. 244-248
Supersonic Flight in the Soviet Union : 5, pp. 256-257
Planes for Payload : 6, pp. 332-334
" Flying Artillery " in the Light of the Korean War—E. Bauer : 6, pp. 335-338
Britain's Air Power Today : 9, pp. 500-507
N.A.T.O. over Holland : 9, p. 513
Design for Production—W. E. W. Petter : 9, pp. 531-534
Twenty years ago : 10, pp. 588-589
Progress Report on U.S. Air Power—Chris Roberts : 10, p. 594
Within the Shadow of Russian Missiles—K. W. Gatland : 11, pp. 632-634
The Weapons System—P. M. Gallois : 12, pp. 719-722

Exhibitions and congresses

Paris Air Show (Programme) : 6, pp. 312-313
Old and New at the 20th Paris Aircraft Show—Maurice Heurteux : 6, pp. 312-313
Foreign Participants at the 20th Paris Air Show : 6, pp. 324-327
Paris Panorama : 8, pp. 379-384
Background to Farnborough : 9, p. 499
Preview of the Turin Technical Exhibition : 9, pp. 518-519
First Impressions of the 14th S.B.A.C. Display : 10, pp. 595-601
Problems of Rocket Propulsion at the 4th International Astronautics Congress : 11, pp. 641-643
Farnborough 1953 : 11, pp. 646-653

Coming Events in International Aviation : 6, p. 347

Aviation finance

Aviation Securities on the New York Stock Market : 2, pp. 93-95

Miscellaneous and humorous

New Year 1953 : 1, p. 11
" Cracker Barrel Philosopher " on Wing Shape Dispute : 1, p. 23
Dressing Fighters for Travel : 2, pp. 89-90
Survival Training : 3, p. 144
Lunch in Casablanca or An Afternoon in Nice—Georges Février : 4, pp. 196-197
Flying over Fujiyama : 5, p. 249
The Air Hostess Told Us : 7, p. 403 ; 8, p. 407
Igor Sikorsky and Interavia : 8, p. 399
Baling out at 50,000 feet : 9, p. 520
Career Women in Uniform : 9, p. 527
" But me no buts " : 10, p. 570
Death of Professor Ludwig Prandtl : 10, p. 581
A Buckshee Ride : 10, p. 584
The Mind of Mr. Reader... : 10, p. 604 ; 12, p. 728
Epic Moments in Aviation : 12, p. 691

Book Reviews

1, p. 49-50 ; 2, p. 104 ; 6, p. 350 ; 9, p. 530 ; 10, p. 590 ; 11, p. 658

What's in the Air ?

1, p. 48 ; 2, pp. 97-98 ; 3, pp. 155-156 ; 4, pp. 207-208 ; 5, pp. 261-262 ; 6, pp. 341-342 ; 7, pp. 407-408 ; 8, pp. 409-410 ; 9, pp. 528-529 ; 10, pp. 592-593 ; 11, pp. 656-657 ; 12, pp. 723-724

Press Mosaic

1, pp. 46-47 ; 2, p. 96 ; 3, p. 150 ; 4, p. 206

Alphabetical Index

Accessories and Equipment Industry, The French : 6, p. 322
Aeronautical Research and Development, British : 7, pp. 385-389
Aeronautical Research during the First Twenty Years of the Century, Italy's Contribution to : 7, pp. 382-385
Aeronautical Research in France : 7, pp. 390-392
Aeronautical Research Seeks New Roads, German : 7, pp. 393-394
Aeronautics in 1953, U.S. : 1, pp. 19-20
AICMA : 10, pp. 580-581
Air Hostess Told Us, The : 7, p. 403 ; 8, p. 407
Air Power, Eisenhower Cabinet Promises Strong : 4, pp. 198-199
Air Power, Progress Report on U.S. : 10, p. 594
Air Power, The Economic and Physiological Limits to : 1, pp. 15-18
Air Power Today, Britain's : 9, pp. 500-507
Air Transport is Vital in War : 4, pp. 175-179
Aircraft Carrier Doomed, Is the : 3, pp. 134-137
Aircraft Carrier, Giant or Pigmy : 3, p. 119
Aircraft Carrier Today and Tomorrow, The : 3, pp. 119-127
Aircraft Carriers, Today's : 3, pp. 128-129
Aircraft Industry 1953, France's : 6, pp. 317-323
Aircraft Industry comes of Age, France's : 6, pp. 314-316
Aircraft Manufacture, Thirty Years of : 12, pp. 709-710
Aircraft of World War II, Little-Known : 2, p. 91
Aircraft Programme, The French Civil : 2, pp. 99-100
Airline Ops with Turbo-Props : 2, pp. 81-83
AISA I-115 : 10, pp. 586-587
America and the Turboprop : 2, pp. 101-102
Approach Procedures for Modern Radio Aids, Standardization of : 6, pp. 348-349 ; 7, pp. 409-413
Assault Transports and Helicopters : 4, pp. 186-190
" Aviation Building " lose its Tenants, Will Montreal's : 1, pp. 43-44
Aviation, Epic moments in : 12, p. 691
Aviation, Germany's Contribution to : 12, p. 717
Aviation on the Way, German : 5, pp. 250-251
Aviation Securities on the New York Stock Market : 2, pp. 93-95
Aviation Trends in " Quadrizonia... " : 9, p. 521

Baling out at 50,000 feet : 9, p. 520
Battle of Arnhem-Nijmegen, The : 4, pp. 179-183

Bombers, Boeing Builds Swept-Wing : 1, pp. 32-34
Book Reviews : 1, pp. 49-50 ; 2, p. 104 ; 6, p. 350 ; 9, p. 530 ; 10, p. 590 ; 11, p. 658
Bristol *Britannia* : 2, pp. 78-80
British-American Jet Transport Controversy, The : 6, pp. 328-330
Buckshee Ride, A : 10, p. 584
" But me no buts " : 10, p. 570

" Canted " Deck, The : 3, p. 125
Career Women in Uniform : 9, p. 527
Carrier-Based Aircraft : 3, pp. 130-133
Centre of Pressure Travel on a Supersonic Wing in the High Subsonic Range : 5, pp. 263-265
Chance Vought *Regulus* : 5, p. 266
Città di Torino Airport : 11, pp. 644-645
Civil Aircraft Programme, The French : 2, pp. 99-100
Civil Air Transport, The Future of : 1, pp. 12-14
Collins' Integrated Flight System : 10, pp. 602-604
Come-Back, A Japanese : 1, pp. 36-39
Comet Crash, Why did the : 8, pp. 411-412
Connie Courts the Customer : 1, pp. 40-42
Control Tower, Le Bourget's New : 6, p. 313
Convair *Sea Dart* : 4, p. 211 ; 10, p. 591
CPA's Ten Years of Service : 10, pp. 578-579
" Cracker Barrel Philosopher " on Wing Shape Dispute : 1, p. 23

Defence or Sound Economy, Accent on : 7, pp. 404-406
Delta—Shape of the Future, The : 1, pp. 29-31
Development of International Performance Standards for Commercial Aircraft, The : 8, pp. 412-415

Electronic Aids for Aviation, New : 9, pp. 534-538
Electronic-Optical Tracking System, The : 11, pp. 659-663
Equipment, Europe's Scientists and Engineers Need Modern : 7, p. 375
Europe laid the Foundations : 7, pp. 376-378

F-100 *Super Sabre* : 12, p. 727
Farnborough, Background to : 9, p. 499
Farnborough 1953 : 11, pp. 646-653
Faster and Higher : 12, pp. 706-707
Fighters for Travel, Dressing : 2, pp. 89-90
Flying, the Birth of : 12, pp. 692-693
" Flying Artillery " in the Light of the Korean War : 6, pp. 335-338
Flying for Fifty Years, Men have been : 12, pp. 694-703
" Flying Palaces " : 9, pp. 514-517
" Forrestal "-Class Carriers, the U.S. Navy's : 3, p. 141
From Glue-Pot to Hall of Giants : 12, pp. 709-710
Fujiyama, Flying over : 5, p. 249

Grandfather taught us How : 12, pp. 711-713
Guided Missile Trends, World : 5, pp. 240-243
Guided Missiles, British : 11, p. 635

Handley Page H.P. 80 : 2, pp. 102-103
He floats through the air with the greatest of ease... : 9, pp. 522-523
Helicopters over New York : 4, pp. 200-203

IATA's Big " At Home " : 10, pp. 568-570
IATA's New Members : 1, pp. 45-46
IATA's Ninth Annual General Meeting, Prologue to : 10, pp. 563-564
ICAO, Business as Usual at : 6, p. 340
Impact of Cargo on Air Transport Planning, The : 5, pp. 252-255
Induction Generators for Guided Missiles : 5, pp. 268-269
Interim Report on an Experiment : 9, pp. 524-526
International Airports, Switzerland's : 10, pp. 582-583
International Air Transport, Prospect and Retrospect : 10, pp. 565-568
International Helibus, Aboard the First : 11, pp. 654-655

Jet Propulsion—a Small Nation's Dilemma : 5, pp. 258-260
Jets for Peace and War, Miniature : 4, pp. 204-205

Landing Run of Jet Aircraft by Thrust Deviation, Braking the : 3, pp. 151-154
Launching System for Self-Propelled Missiles : 11, pp. 663-664
Lunch in Casablanca or An Afternoon in Nice : 4, pp. 196-197

" Mainbrace ", The Truth about : 9, pp. 510-512
Maintenance as Safety Factor : 3, pp. 148-149
Maintenance of Aircraft Electrical Equipment : 4, pp. 209-211
Materials for Rocket Combustion Chambers : 5, pp. 266-267
Memories of a Designer : 12, p. 718
Missiles, Within the Shadow of Russian : 11, pp. 632-634

NATO over Holland : 9, p. 513
New Year 1953 : 1, p. 11
Noises off : 8, p. 408

Old and New at the 20th Paris Aircraft Show : 6, pp. 312-313

Parachutes as Weapons : 4, p. 176
" Paramedics " and " Paranurses " : 4, p. 195
Paris Air Show (Programme) : 6, pp. 312-313
Paris Air Show, Technical Review of the : 8, pp. 385-400
Paris Panorama : 8, pp. 379-384
Participants at the 20th Paris Air Show, Foreign : 6, pp. 324-327
Passenger Doesn't See, What the : 2, pp. 87-89
Piloted Delta-Wing Interceptor, The : 11, pp. 664-665 ; 12, pp. 725-727
Pilotless Aircraft, the Control of : 11, pp. 638-640
Pioneer's New Personnel Parachute : 5, p. 255
Planes for Payload : 6, pp. 332-334
Prandtl, Death of Professor Ludwig : 10, p. 581
Press Mosaic : 1, pp. 46-47 ; 2, p. 96 ; 3, p. 150 ; 4, p. 206
Production, Design for : 9, pp. 531-534
Propeller Turbine Oust the Piston Engine ? Will the : 2, pp. 76-77
Propeller Turbines, Civil and Military : 2, pp. 72-76
Propellers for Gas Turbines : 2, p. 86

Ramjets and the Work of René Leduc : 7, pp. 400-403
Ratification of German Treaties, German Aviation Awaits : 2, p. 92
Ready to Sail : 3, pp. 142-147
Research, A New Start for German : 7, p. 394
Research Rocket, The *Aerobee* : 11, p. 631
Robots Join the Arsenal : 5, pp. 231-237
Rocket Development in France : 11, pp. 636-637
Rocket Industry, America's Growing : 11, p. 630
Rocket Missiles, American : 11, p. 630
Rocket Propulsion at the 4th International Astronautics Congress : 11, pp. 641-643
Rockets for Peace and War : 11, p. 627
Rockets over Alamogordo, Boeing : 5, pp. 238-239
Rocketry, A few Comments on : 11, pp. 628-629

SBAC-Display, First Impressions of the 14th : 10, pp. 595-601
Shape—Straight, Swept or Delta, What's in a : 1, pp. 21-22
Sikorsky and Interavia, Igor : 8, p. 399
SNECMA *Escopette* Pulse Jet, The : 6, 343-347
Soviet Paratroops over Western Europe : 4, pp. 184-185
Steam Catapults for U.S. and Royal Navies : 3, p. 123
Supersonic Flight in the Soviet Union : 5, pp. 256-257
Survival Training : 3, p. 144
Swept-Wing Bombers, Boeing Builds : 1, pp. 32-34

TAP Becomes a Private Airline : 9, p. 520
Target Aircraft : 5, pp. 244-248
TCA Progress, Fifteen Years : 10, pp. 575-577
Test Pilot Reminisces, A : 12, pp. 713-715
The Mind of Mr. Reader... : 10, p. 604 ; 12, p. 728
Tools for the Old World, New : 7, pp. 379-381
Transport Glider Operations in World War II : 4, pp. 191-194
Turbine-Powered Commercial Aircraft : 2, pp. 68-71
Turboprop-Aircraft : 2, p. 67
Turboprop Giant, Assembling a : 2, pp. 84-85
Turin Technical Exhibition, Preview of the : 9, pp. 518-519
Twenty years ago : 10, pp. 588-589

United Air Lines' Airdock Project : 6, p. 339

Warner Sums Up, Dr. : 8, pp. 406-407
Weapons, Fantastic : 5, p. 231
Weapons System, The : 12, pp. 719-722
What's in the Air : 1, p. 48 ; 2, pp. 97-98 ; 3, pp. 155-156 ; 4, pp. 207-208 ; 5, pp. 261-262 ; 6, pp. 341-342 ; 7, pp. 407-408 ; 8, pp. 409-410 ; 9, pp. 528-529 ; 10, pp. 592-593 ; 11, pp. 656-657 ; 12, pp. 723-724
What's it like at 100,000 feet : 4, p. 197
Wing—Aerodynamic Step-Child or Supersonic White Hope, The Straight : 1, pp. 34-35
Wings, An Engineering Comparison Using Straight, Swept and Delta : 1, pp. 23-27
Wings ", Comments on " An Engineering Comparison Using Straight, Swept, and Delta : 1, pp. 27-29
Woomera breaks the News Barrier : 9, pp. 508-509
World Air Transport, Pillars of : 10, pp. 571-574
Wright Brothers' Anniversary, An American's Comments on the : 12, pp. 704-705

Zürich's Flughof : 8, pp. 401-405

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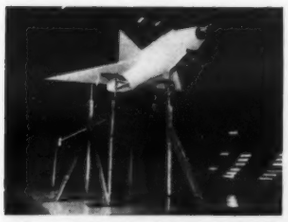
Contents

OUTLOOK FOR 1953
New Year 1953 11
The Future of Civil Air Transport H. ZIEGLER, PARIS 12
The Limits to Air Power P. M. GALLOIS, PARIS 15
U.S. Aeronautics in 1953 C. ROBERTS, WASHINGTON 19
SUPERSONIC WING SHAPES
What's in a Shape ? S. BANGS, LOS ANGELES 21
Straight, Swept and Delta Wings K. E. van EVERY 23
Comments on Wing Shape Comparison L. P. GREENE 27
The Delta — Shape of the Future * * * 29
Boeing Builds Swept-Wing Bombers ROBBINS & COOK, SEATTLE 32
The Straight Wing S. BANGS, LOS ANGELES 34
A Japanese Come-Back ? 36
Connie Courts the Customer 40
Will Montreal's "Aviation Building" Lose its Tenants ? 43
IATA's New Members 45
Press Mosaic 46
What's in the Air ? 48
Book Reviews 49



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NACA made flow tests on the prototype of the Convair XF-92 A experimental delta aircraft in the Ames Laboratory wind tunnel at Moffett Field during the winter of 1947/48. The tunnel measures 40 x 80 feet and has flow speeds of up to 250 m.p.h.

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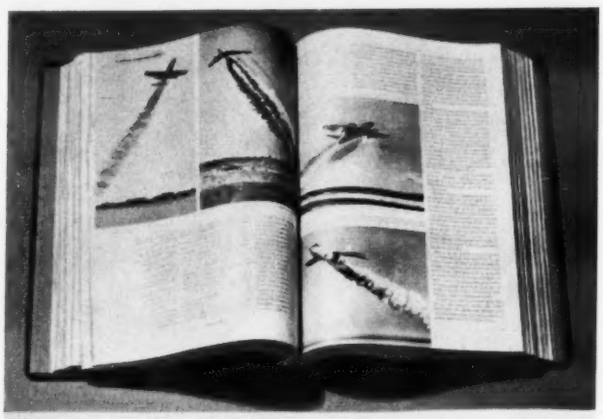

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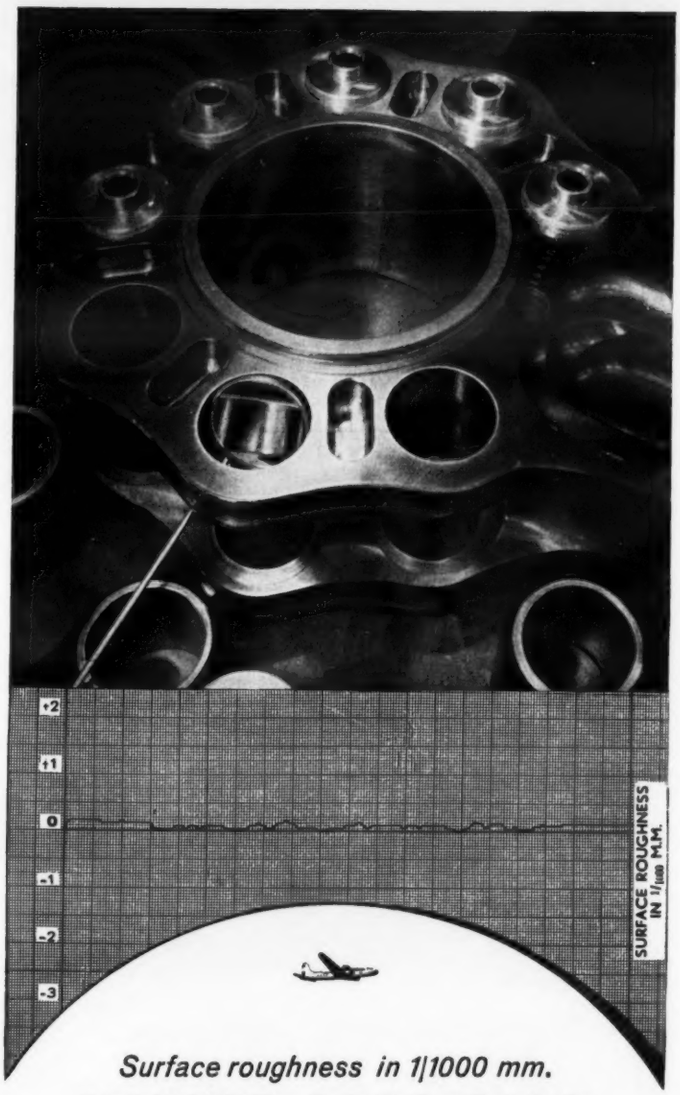

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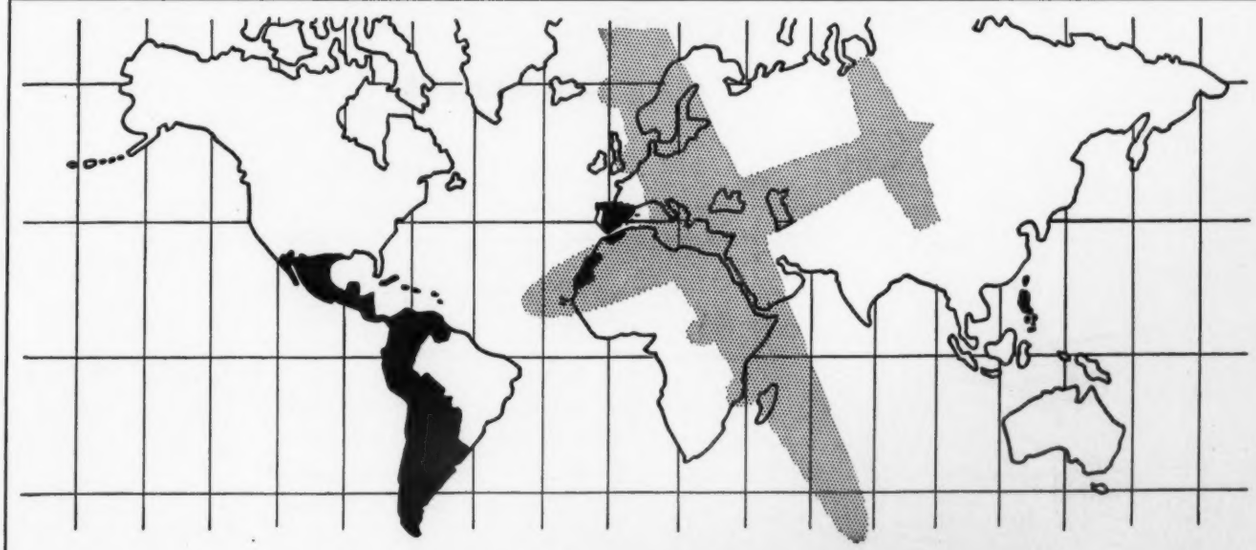

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Since flying began, Canada has been an airminded nation, and as new uses for air raft are discovered, Canada will lead in applying them to her way of life.

New Year 1953

Everybody on our Editorial Staff would have loved to take life a little easy in the Christmas month . . . It would have been nice, for example, simply to wish our readers a "Happy New Year" and to tell them that everything in the world, including aeronautics, was just fine. If this were true, everybody would be happy. Unfortunately the hard facts of life keep staring us in the face.

Since we are not always convinced of the infallibility of our own opinions, we approached some outside experts for help. We asked a number of INTERAVIA friends, well-known to our readers and in the world of aviation, for their views. We read their manuscripts in growing gloominess : the opinions of our friends were not particularly optimistic, either.

Henri Ziegler, Director-General of Air France, acknowledges the rapid progress air transport has made in the past few years, particularly in 1952. Jet transports have entered commercial airline service, tourist rates have been introduced on some international trunk routes. But Ziegler feels some anxiety when studying the economic development of the industry in the future. Unless the countless airline companies—some of which operate on a shoestring—get together and cooperate both in the fields of maintenance and operation and work out a joint programme, their prospects are none too reassuring.

Colonel Pierre Gallois, of the French Air Staff, admires the high quality of the new combat aircraft . . . and feels that they are nearly too perfect. He believes that with the creation of continuously more complex and expensive types quantity production becomes well-nigh impossible. He fears that the human factor will not be able to keep pace with engineering advances. And he figures out that even the most well-heeled Treasury will find one day that it is scraping the bottom of the barrel. Where does all this lead ? Like Ziegler, the air transport expert, Air Force expert Gallois refrains from engaging in destructive criticism. On the contrary, he suggests ways and means of discarding the 1952 trend towards ever more complex aircraft and equipment.

From the New World we received an appraisal of the situation written by our Washington Correspondent, Chris Roberts, a tough, experienced aviation journalist who is in daily contact with air transport executives, air force brass, industrialists, Congressmen and politicians. He outlines how aviation may develop under the coming Eisenhower regime. There is not much consolation in what he says . . . Money does not grow on trees even in "democracy's arsenal," the apparently inexhaustible source of funds for a "disinherited" Europe, the citadel of industrial research and production. While the arms programme will not actually be cut back, it will be "stretched out." The American air transport industry, too, will have to consolidate if the Eisenhower Administration should have qualms in doling out subsidies. As regards the aircraft industry, it looks as if our French friend Gallois and INTERAVIA with him almost lived a visionary moment last summer when we dealt with the "short-life aircraft" (No. 7, July 1952) in, to our knowledge, the first serious discussion of the subject. The USA, too, feels that in the field of engineering it has to go "back to nature." The call is for "de-refinement"—both manufacturers and pilots should not be burdened with demands surpassing their capabilities. The conception of the "short-life," "stripped-down" or "expendable" aircraft is being studied all over the world.

The three articles by Ziegler, Gallois and Chris Roberts belong together and form the first of the New Year 1953 issue of INTERAVIA. Though it is critical in places, it is constructive as a whole, and constructive criticism always gives rise to hope.

*

The second part of the issue is devoted to technical problems.

Incidentally, we wish to remind our readers at the beginning of this year 1953 that powered flying can now celebrate the first half-century of its existence. Only fifty years ago... On December 17th, 1903, the Wright Brothers first flew their aircraft at Kitty Hawk over distances of 130 feet, 210 feet and 930 feet. Speed was about 25 m.p.h. No record—but the *first* powered flight !

Where are we today ? As long as seven years ago a twin-engined Lockheed P2V "Neptune" flew half around the globe without intermediate stop or flight refuelling, a distance of 11,235 miles. In 1951 Bill Bridgeman flew his Douglas D-558-2 "Skyrocket" at 1,238 miles per hour for a few seconds.

At the present time aircraft designers everywhere are pondering the shape of *future aircraft capable of sustained supersonic flight.* The kind of aircraft—let us be peaceful—that will enable us in the next few decades to take a trip from Paris to New York in two or three hours.

The traditional annual air show organized by the Society of British Aircraft Constructors last year gave a public demonstration of supersonic flight by swept-wing fighters. It also showed us another innovation in the form of a series of delta-wing aircraft which, in some expert opinion, is revolutionary. Many are those—and not only Britons —who regard the delta as the Alpha and Omega of future supersonic development.

A month later it was announced from the USA that the Douglas X-3, at present the world's fastest aircraft, reputedly capable of a top speed of about 2,000 m.p.h., had made its first flight. It has straight wings.

What does it all mean ? It means, to say the least, that the experts disagree, that they are still seeking the right solution. On numerous occasions *American aerodynamicists* have sat down together to exchange their ideas on the best wing plan form for supersonic aeroplanes.

INTERAVIA's indefatigable "newshound" on the U.S. West Coast, *Scholer Bangs,* pounced on this opportunity of consulting the leading aerodynamicists of Douglas, North American, Boeing, Convair, Lockheed and Northrop to obtain their opinions. The result, which he has called "What's in a Shape ?," is a symposium on the wing plan forms for tomorrow's supersonic aircraft.

*

We wish a Happy New Year to our readers and friends. We are glad that they can be found in every corner of the earth. And they may be glad to know that we shall continue to do our best. *E. E. H.*

The Future of Civil Air Transport

BY HENRI ZIEGLER, DIRECTOR-GENERAL OF AIR FRANCE

A group of French air force officers at the CEMA test centre at Villacoublay, near Paris. Charles A. Lindbergh was paying a visit to his French flying friends in the years before the war. Centre is Colonel Delattre, Commandant of CEMA ; left, Colonel Lindbergh ; right, without cap, a young officer wearing a leather coat : Captain Henri Ziegler, *Air Force Engineer, Deputy Commandant of CEMA. Today he is the Director-General of Air France. Why this picture ? It emphasizes the author's career : engineer, Air Staff officer, several thousand flying hours at home and abroad, more than half of them at the controls of prototypes. A practical airman who knows about flying not only from sitting at the conference table.*

It is a fascinating task, at the beginning of this new year, to analyse the present state of world air transportation by examining the principal events that have marked the past few months.

Two facts are prominent in the memories of all : the adoption of jet-propelled transport aircraft on some of the world's trunk air routes, an achievement made possible through the joint action of The de Havilland Aircraft Co. and British Overseas Airways Corporation ; and the introduction of tourist fares on the North Atlantic routes, a measure in which Pan American Airways played a leading role.

Other, less obvious facts are also of great significance if our analysis is extended to include their potential results. Among these we should note, in my opinion, the mounting difficulties that have been encountered in the elaboration of tariffs at the IATA Traffic Conferences and the arbitrary action of the Republic of Argentina, which decided to introduce a form of discrimination among the rates set for the local operators in a certain zone of South America.

We shall endeavour to consider these events in their proper perspective and to derive from them certain pointers to the immediate and the more remote future.

*

On the basis of their rising traffic figures and the remarkable expansion of their operations, air carriers claim that their work has become an activity of great importance to world economy.

This activity is great, without a doubt ; few are the industries which have experienced a similarly sustained and rapid growth, a sign both of the importance and the quality of the service rendered to the public and—let us not be falsely modest about it—of the passionate devotion to duty of the men engaged in it.

But it would certainly be premature to say that this activity has assumed major economic importance since, on the whole, revenues meet expenses only with difficulty and sometimes not at all. To a greater or less extent, all carriers resort to the help of public concerns, and the wealth and variety of methods and means they employ are a credit as much to their imagination in this financial field as to the very general good will of the helping concerns. *A fortiori,* while the operating expenses are not always balanced by operating revenues, the problem is even more serious as far as capital investment is concerned. All carriers are showing a remarkable degree of faith in the future by incurring heavy debts in order to build up modern air fleets in keeping with their needs ; this faith is certainly justified since it seems to be shared by the bankers, and bankers are notoriously not in the habit, when granting large loans, of accepting unsubstantiated arguments to cover the risks they take. It is nevertheless a fact that the indebtedness of the air transport enterprises is unusually heavy in comparison to that of most other great branches of industry. Moreover, many of the companies are retarded in their growth by the insufficiency of their financial resources, very often because during their brief existence they have not had time to accumulate adequate funds.

The heads of these companies must regard it is as a duty of paramount importance to lead their enterprises towards greater financial stability in order to consolidate and improve not only the services rendered to the public but also stability of employment.

The most urgent aspect of this problem is the reduction of operating expenses. This means that a constant search must be made for more economical flying equipment and for methods of spreading out fixed costs.

The equipment problem is naturally ever-present, and there is no question that the rapid strides of the airline industry have been due largely to the remarkable advances in aeronautical engineering.

The French Air Force's test centre at Villacoublay received a visit from Charles Lindbergh a few years after his historic flight across the Atlantic. *Left to right :* Pierre Trebod, test pilot, killed in action 1940.—Maurice Claisse.—Major Demmery, then deputy head of Villacoublay test centre.—Major Tuffal, now attached to Avions Marcel Dassault.—Charles Lindbergh.—Soulier, Air Force engineer.—Cambois, killed in a motor accident.—Colonel Housset, now with the Air Ministry's Equipment Section.—Colonel Delattre, then head of Villacoublay test centre.—Perrin, Air Force engineer.—Captain Maréchal, killed in action in 1940.—Henri Ziegler, now managing Director of Air France, then assistant head of Villacoublay test centre.—René Le Bail, Manager of Avions Marcel Dassault's Saint-Cloud factory.—Lieutenant Genin, killed on active service.—Michel Détroyat.—Colonel Rozanoff, chief test pilot at Avions Marcel Dassault.—Colonel Ladouce, assistant head of the Brétigny flight test centre.

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The evolution of piston-engined aircraft has consistently aimed at a reduction in cost per ton-mile, and this has been achieved by increasing gross weight and power and improving the aerodynamic qualities of the airframe.

*

What prospects has the appearance of the jet engine in the commercial transport field opened up today ?

We are convinced that the arrival of the commercial jet is nothing short of revolutionary. The increase in flying speed which in many cases will cut travelling time by half, the smoothness of flight at great altitudes combined with the elimination of vibration which experts had regarded as the permanent curse of the aeroplane, must convince passengers that the piston-engined airliner has become a second-class type of transport.

The problem no longer is to determine whether the jet airliner will or will not attain a degree of operating economy equal or superior to that of the piston-engined aeroplane. The problem now is to reach this economy at all costs—for the jet transport has come to stay. Considerations of safety alone could still have made the public hesitate. But the brilliant results achieved by BOAC in several months of operating the "Comet" are an eloquent reply to the sceptical, a reply which the incident of the "Comet" crashing on take-off at Rome has only reinforced; any "conventional" aircraft would have burned up under similar conditions, possibly with considerable loss of human life.

It is fortunate that the rapid development of modern jet engines promises a satisfactory answer to the question of operating economy. The problem has been to find out within what period of time the consumption of the jet engine could be diminished and its operating life lengthened.

*

Unceasing research has produced, within a few short years, new alloys capable of withstanding severe stresses at ever-increasing temperatures. The problems presented by turbines and combustion chambers are thus moving rapidly towards solution, and it has therefore become possible to increase the compression ratios of jet engines, and, while increasing their output, to reduce their fuel consumption. The practical results have been surprising. In eight years, from 1944 to 1952, fuel consumption has dropped from 1.2 pounds per pound of thrust to about 0.72 pounds, a saving of about 40%. The greatest optimists would have hardly dared hope for such a rapid improvement. Simultaneously, the time between overhauls of jet engines, which was about 50 hours in 1946, is now 500 hours in most cases, and we are confident that it will quickly attain and surpass the 1,500 hours representing the optimum between-overhaul time of a very good piston engine.

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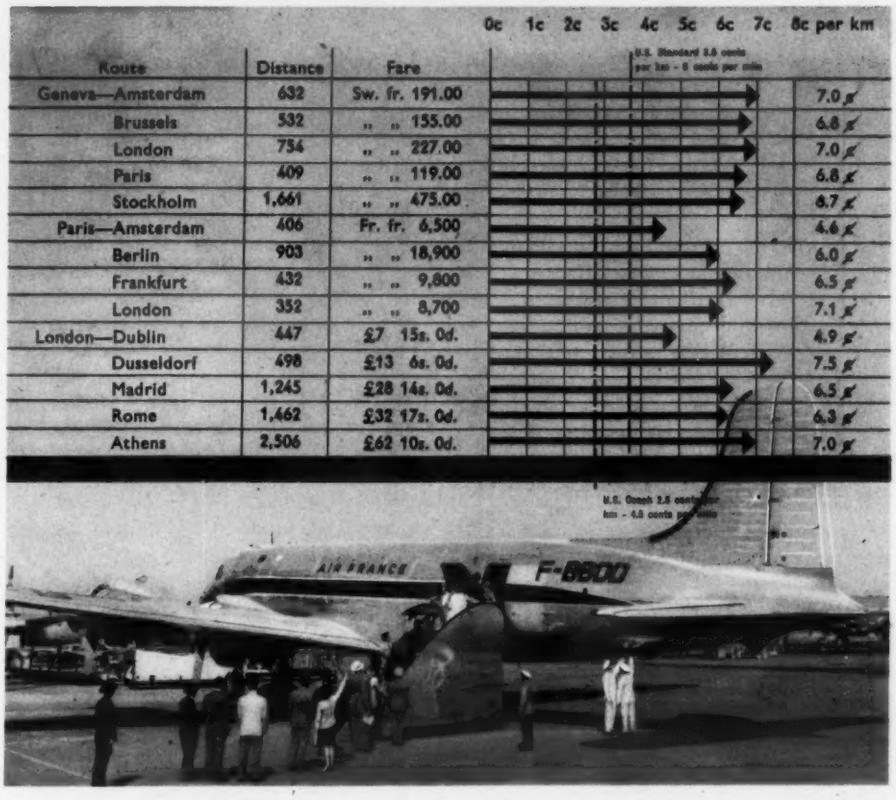
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Dusseldorf 498 £13 6s. 0d. 7.5
Madrid 1,245 £28 14s. 0d. 6.5
Rome 1,462 £32 17s. 0d. 6.3
Athens 2,506 £62 10s. 0d. 7.0
AIR FRANCE
F-BBDD

With these improvements close at hand, it is a certainty that within the near future jet-propelled transports will be available which will be capable of flying any important trunk route in the world, the North Atlantic route included, with an operating economy equal to or better than that of the best modern piston-engined airliner.

On the other hand, it is reasonable to think that the jet-propelled transport will also adapt itself to the operation of medium-stage lines which until recently seemed to be outside its natural domain.

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Does this sound the death-knell of the propeller-turbine aircraft ?

In principle, the propeller-turbine today still offers undoubted theoretical interest. Nevertheless, we consider it as unlikely that this type of power plant will assert itself, owing to its great mechanical complexity. The propellers absorbing today's great engine powers have already become a nightmare for the operators who know to their sorrow all the effort and all the expenditure involved in their maintenance and overhaul. In addition, no high-power propeller turbines have yet reached the same advanced stage as reciprocating engines or straight jets, and it would cost considerable sums of money to bring them up to this pitch.

*

We shall not dwell on the problem of the helicopter, tomorrow's probable short-stage aircraft, or on supersonic commercial transports or atom-powered transports, since we wish to confine ourselves to questions of immediate importance. But there is one aspect of the equipment problem which we think is of particular interest, namely, the cost of maintenance and overhaul facilities.

The combination of aircraft and workshops can completely transform the physiognomy of an operation from the point of view of both quality and economy of operation. It is surprising how much time it takes completely

Growth of air transportation

International and Domestic Scheduled Airlines [1]

	Aircraft km	*Passengers carried*	*Passenger kilometres*	*Cargo ton-km 1000*	*Mail ton-km 1000*
1937	269,000,000	2,500,000	1,425,000,000	....	....
1946	954,000,000	....	15,678,000,000	....	....
1947	1,156,000,000	21,100,000	19,100,000,000	297,000,000	132,000,000
1948	1,292,000,000	23,600,000	21,200,000,000	459,000,000	169,000,000
1949	1,345,000,000	26,500,000	23,300,000,000	569,000,000	187,000,000
1950	1,432,000,000	31,200,000	27,300,000,000	757,000,000	209,000,000
1951	1,550,000,000	39,000,000	33,984,000,000	899,000,000	239,000,000
1952 [2]	1,700,000,000	45,000,000	45,000,000,000	1,000,000,000	275,000,000

[1] USSR excluded all years, China since 1949.
[2] IATA member companies only, exclusive of most purely domestic carriers; estimated.

to "digest" a new type of aircraft with all its complex equipment, instruments and accessories. It is not only that tools and working methods must patiently be perfected. The technical skill of maintenance workers also has an important effect on the longevity and rate of utilization of the aircraft. As aircraft become more complicated and more precisely engineered, the skill of the craftsman recovers increasing value in relation to the machine.

After the air fleet, the major item of expenditure consists of fixed operating costs. It is obvious that within reasonable limits these costs decrease proportionately to the size and degree of standardization of the air fleet and to the intensification of operating schedules on each line.

These various factors raise the question of consolidating the air transport industry.

For various reasons, not the least important among which are the particularly pronounced individuality of airmen and the aeronautical *amour propre* of even the smallest communities, we periodically witness a multiplication of air carrier enterprises. The peculiar circumstances of the post-war years, and especially the large numbers of war-surplus aircraft which were sold virtually at scrap prices, have created a completely false impression. But stark reality always asserts itself, and today it is very plain that for obvious technical and economical reasons a concentration of available resources is inevitable. Once again the American air transport industry is showing the way : The U.S. Civil Aeronautics Board and the air carriers have continuously before them a variety of consolidation and merger proposals to reduce the number of domestic air carriers. The situation will evolve very slowly, partly because of vested interests and partly because of national prestige. But it is better to keep a watchful eye on this evolution in order not to be caught napping.

*

This brief study of some of the internal aspects of air transportation should be completed by an examination of the external aspects in the light of the travelling public's wishes and criticisms.

Without exception, the low-fare experiments conducted so far have been a resounding success which substantiates the claim that the great mass of the travelling public desires—and forcefully desires—to travel at the lowest possible cost, even though this means the elimination of certain features of the super-comfort which air carriers have endeavoured to offer at no extra cost.

We have previously described in these columns[1] the fundamental contradiction between the aircraft as a means of transport and the aircraft as an expression of luxury. Luxury implies three elements, namely, time, spaciousness and great weight-carrying capacity, and all three are in opposition to the essential characteristics of the transport aircraft.

It cannot be over-emphasized that the aircraft adapts itself easily to the needs of a large, but less wealthy and less exacting public. By reducing tariffs, new traffic is created, because lower rates enable an enormous number of potential passengers to travel over medium distances for business or pleasure. So far, even if they had travelled at the lowest surface rates, the time factor would have been an insurmountable obstacle.

Smooth adaptation of maintenance facilities to flying equipment is of decisive influence on the quality and economy of operation. Here an Air France "Constellation" in the last stages of being prepared for take-off.

A consistent policy of lowering rates does not only serve the interests of the carrier, who thus finds a much wider and more stable financial basis, but also fulfils an essential economic and cultural task which at last gives the transport aircraft its full meaning.

We believe, therefore, that modern high-speed, high-density transport aircraft offering the lowest possible fares will inexorably become the standard means of air transportation.

Luxury airliners will assume a more exceptional character and will be confined to trunk lines on which a sufficiently large number of wealthy patrons is available. The luxury aspect on these services will have to be enhanced considerably and will have to be paid for. The supplementary charges now in force on the North Atlantic, for example, are quite insignificant and do not reflect the difference in the quality of service. They will have to be raised as they have on the American domestic services.

At this stage of our analysis we come to the study of transport problems on a world level. Wayne Parrish, an American aviation publisher, recently emphasized certain difficulties encountered by the International Air Transport Association.

IATA was born of the voluntary association of a large number of air carriers who had realized that aviation could only develop if it offered the public a homogeneous world-wide organization. In the absence of such an organization, air transport would flounder in inextricable difficulties and financial hazards.

In the light of these imperative requirements, IATA has accomplished a remarkable task. Why is it, therefore, that divergences which have always been settled now look more insurmountable than in the past ? This is due in the first place to one of the points we have discussed above, namely the fact that air carriers often work on too small a scale, disregarding the economic necessity of a policy of consolidation. Then, rather than carry out bold reforms, many of them who labour under difficult conditions appeal for protection to the forum of IATA.

Thus, as a result of a peculiar paradox, we sometimes find that an institution whose primary purpose is the development of air transportation slows down this development whenever a member pronounces a veto against measures which clearly would be in the interest of the travelling public.

Another aspect of these difficulties has manifested itself in a gradual shift towards "zonal policies," a tendency which enlarges to a greater or smaller extent the concept of cabotage so as to embrace groups of countries constituting a single geographical unit. This development has much for and much against it.

It is well known that outside the United States regional air transport operations drag along under fairly miserable conditions. They are the source of all the deficits. The aircraft must work within sufficient space to make the best use of its qualities. Most countries are too small in relation to the speed and range of modern aircraft, domestic traffic is insufficient, and inter-state traffic is paralysed by too many impenetrable carriers.

The concept of the "zone" thus appears not only as an advance, but probably also as a necessity, on condition that it is guided into a direction favourable to the public interest and not *against* the legitimate interests of one or the other air carrier not belonging to the zone.

Such a "zonal policy" cannot be conducted either by the air carriers themselves, or independently by the individual nations : it requires the harmonious cooperation of the air carrier groups with the corresponding group of states.

Some of the aims of this cooperation can be defined :

—synchronisation and coordination of surface facilities, especially navigation aids ;
—revision of customs and fiscal policies to facilitate the movement of aeronautical equipment, such as aircraft, accessories, spare parts, etc., with a view to ensuring a system of mutual aid between air carriers in the field of maintenance and overhaul ;
—reduction in taxes on fuel and oil ;
—revision of legislation governing ownership of aircraft to widen the use of aircraft along the lines of railroad transportation ;
—finally, widening of present policies in the exchange of traffic rights.

All these requirements are particularly urgent in the European air transport field.

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In conclusion, we would state that, while the steady expansion of air traffic and the public's continued confidence justify the highest degree of optimism, we must beware of regarding the present situation of air transportation as stable.

We think we have shown that many concepts which today are considered as established are in need of revision and that structural reforms must be undertaken with as much boldness as wisdom.

The greatest hopes are justified if we enter upon this difficult period fully conscious of the obstacles in our way and with the courage necessary to adopt solutions which will also be valid in the more remote future.

[1] Cf. "INTERAVIA, Review of World Aviation," No. 9, 1951, page 486 : "Outlook for Air Transportation."

The Economic and Physiological Limits to Air Power

BY PIERRE M. GALLOIS, PARIS

Even before the end of 1952 the Western world had had to admit that in the domain of rearmament, as in others, it had been cherishing false hopes. Financial restrictions, industrial difficulties, human limitations due to man's inability to adapt himself to the machines he has created, all combine to distort the normal evolution of conventional air arms. Economists and politicians talk of "stretching out" the programmes. Engineers are seeking designs that will be both less costly and more human. As for the military, they too are asking the cost of efficiency.

Let us look back a moment. Four or five years ago, 1952 was forecast as the crucial year, the year when the Russians were expected to detonate their first atomic bomb. The experts were caught napping ; Soviet scientists reduced the time allowed them for these developments from six years to three. In reality, if 1952 is the year of the H-bomb, it is also the year of "stretch-outs" in armament programmes and of the first wide-spread stirrings of doubt as to the validity of the solutions hitherto applied to the problems of rearmament. Must doctrines, backed by years of success, be reversed ? Are conditions so different that the criteria of ten years ago are no longer valid ? Are the economic barriers of today and the physiological barriers of tomorrow more difficult to surmount than those of speed and altitude ? Are these fears just as unfounded as those expressed only twenty years ago when the first fighters with speeds of 250 m.p.h. appeared and were over-hastily condemned as unsuitable for combat duties because of their very performance ? Or is the air arm so far in advance of the world's political evolution and its tendency towards concentration that it will one day disappear from the military panoply of all but the Very Great Powers ? Machiavelli, in his age, had already grasped the revolutionary changes which artillery was to make in the political structure of the Christian world. Only the Great Powers could afford artillery. Thus the principal result of this innovation was "to favour the big states and the powerful principalities to the detriment of the small republics and localities which are still jealous of their independence." True, we have not reached this point, but is this because the air arm has not everywhere enjoyed the same favour or, apparently, the same priority as did the artillery in its early days, or is it that in proportion there is less disparity between our resources and our ambitions ?

Britain's plans

On July 30th last Churchill reminded the House of Commons of the Labour Government's plans, drawn up with commendable zeal but not with adequate study, to spend £3,600,000,000 on rearmament over a period of three years, and of how this figure had later been increased to £4,700,000,000. Today defence must be founded on a new conception which does not go on costing more and more in money and material year after year. Technical progress and the use of weapons that are revolutionary in cost and effects enable substantial reductions to be made in the original estimates, the Prime Minister continued. It must not become an inviolable principle that the needs of defence should take absolute precedence over exports, or vice versa. The suggestion had been made that arms production should be cut and greater effort expended on the production of consumer and export goods. But such a policy would be unwise. Aircraft could be made for export too. This would not only keep the armament industry in running order and thus build up the production capacity which would become indispensable if it came to war, but also strengthen Britain's allies and friends.

A few days earlier Richard Denman had written in the "Economist" that if it could get over its present labour shortage, the British aircraft industry would be in a good position to help in the export drive. It could do so within the framework of the U.S. Mutual Security Agency's recommendations that a substantial portion of Western European air forces should be equipped with the latest fighters built in Britain. These fighters would be paid for with the aid of American dollars. Thus British jet aircraft would strengthen Western defence, while American off-shore orders in Britain would buttress the British economy. This is the best illustration of a policy which reconciles the requirements of rearmament and the advantages of exporting.

One reason for America's "off-shore" purchases : *right*, two North American "Sabre" fighters. Each costs about $350,000, plus armament and equipment. *Left*, a Vickers-Supermarine "Swift" fighter, now in production for the RAF and NATO air forces. It costs the equivalent of only about $170,000.

It took about nine years to get the Boeing B-47 "Stratojet" bomber into operational service : 1943-1947, design, engineering and prototype construction ; 1947-1949, testing, development and modification ; 1949, beginning of production ; 1952 : squadron service.

The only trouble is that almost all the countries with an industrial potential of any size argue along the same lines. And just as, five centuries ago, the artillery was the concomitant of power and guaranteed the independence of a state, today it is aviation which plays this part. Hence aircraft industries everywhere are seeking to expand their markets, but the latter are either hampered by lack of funds or already amply supplied by their own national production capacity. Efforts at exporting are all the more discouraging because markets are not free, since national prejudice will not always permit foreign equipment to be purchased, even if it is cheaper or of better quality. This is quite natural when it is considered that the air arm and the technical developments behind it are the bulwarks of power in this age of atomic dominance.

America postpones her target date

In spite of its formidable power and resources that appear unlimited from the European view-point, even the United States has "stretched" its aircraft procurement plans. In May 1951, when the budget for fiscal 1951-52 was being discussed, the target was announced as 95 wings by the end of 1951, 120 in 1953 and 150 the following year. Since then, successive postponements have spread this programme over a longer period. The debates on the U.S. Air Force's budget for 1952-53 underlined the financial burden encountered. The Air Force originally asked for 21,400 million dollars. The President cut this figure by 700 millions and thus put back to the end of 1955 the establishment of the 143-wing

Single-purpose aircraft instead of multi-purpose machines. The Douglas F4D "Skyray" is a catapulted, short-range naval interceptor.

force. Finally, in view of the feeling aroused by these cuts and protests by the Senate itself, President Truman on July 10th signed a military budget of 46,500 million dollars, including 21,118 millions for the Air Force (143 wings before the end of 1955). A compromise had been arrived at. The Joint Chiefs of Staff Committee's recommendation that 143 wings (126 combat and 17 transport wings) were essential from 1954 onwards to ensure the safety of the United States would not be implemented, but more could be done than the attitude of the House of Representatives, postponing completion of the programme to the end of 1957, had led one to fear.

Wanted : winged weapons

Thus even America has had to compromise on the cost of her air arm. The budget discussions created considerable stir in military and technical circles on the other side of the Atlantic, and most of the American periodicals last summer and autumn wrote at length on either the high cost of modern flying equipment, or its excessive complexity. Numerous articles were published drawing attention to the cost of the slightest improvements, and some writers even went so far as to admit that much simpler aircraft, if not actual "short-life" types, might perhaps be the solution to the problem which had just confronted the West for the first time, that of obtaining operational efficiency at a lower cost. For example, Air Force ace Gabreski told reporters on the semi-official review "Air Force" that although there was no doubt of the quality of the American flying equipment, a considerable effort at simplification should be made. Aircraft should have all unnecessary instruments and equipment removed and, if possible, have their fire power increased. In short, the aircraft desired by the pilot himself tended to be a winged missile rather than an armed vehicle. And Robert Wood, editor of "Aviation Week," quoting statements made at meetings of the Institute of the Aeronautical Sciences, wrote : "Our aircraft designers definitely are thinking in terms of lighter, more simplified planes for the future. They are worried about the trend toward heavier and complicated aircraft. Future designs call for lighter bombers, as well as fighters." At Douglas, E. H. Heinemann has made himself the spokesman for "simplification." In a recent article he showed that a hundred million dollars would have bought 1,150 fighters in 1930 but less than 100 twenty years later. Defining what he calls the "growth factor," Heinemann explained that the mere fact of adding an automatic pilot to a fighter increased the gross weight by over 1000 lbs. At $40 per pound, this increase in weight adds $40,000 to the cost of the finished aircraft if performance is maintained. The ejector seat adds another similar sum to construction costs, and a de-icing system for the wings almost three times as much.

Even for American industry, which is more amply provided with funds than any other, 1952 may well mark the beginning of a new era, in which the brake is put on the weight and complexity, and hence the cost, of flying equipment.

While Britain is staking much on the exportation of her best civil and military aircraft types, in America opinions are divided on the advantages of the off-shore procurements policy, i.e. the purchase of complete aircraft built in Europe for the air forces of the European NATO powers. For example, "Aero Digest" for last October wrote that the off-shore tangle "started when the Congress appropriated $225 million for the purpose of off-shore spending for aircraft through MSA. In theory, the other NATO countries are to provide $175 million

to make a $400 million 'kitty' to be spent for the rather vague purpose of priming the European aircraft production pump as well as—perhaps—obtaining some airplanes." Such opposition to the United States Government's policy is not general. And it has been stressed in the many discussions on off-shore orders that their principal advantage lies in the lower cost of aircraft built on this side of the Atlantic. The Supermarine "Swift" for example is quoted at about $170,000, while the "Sabre" costs about twice as much. Once again, the cost of flying equipment has been a decisive factor in the adoption of a policy of external aid which is obviously not welcomed with equal enthusiasm by all American manufacturers.

Today's funds buy only 8% of what they bought in 1942

Like Britain and the United States, France too has had to spread out her original rearmament plans. The war in Indochina eats up thousands of millions of francs in her military budget that would otherwise be used to finance her NATO commitments. When the Three Wise Men agreed, logically, to base each country's contribution to defence expenditure on its national income, they decided the military budgets of each of these countries. France has exceeded the contribution required of her. But here, too, as in America and Britain, there is a disparity between the cost of rearmament plans and the amount of military credits decided upon by mutual accord. Without the war in Indochina the Wise Men's calculations would have been accurate, and France would have had no great practical difficulty in balancing plans and realities. In spite of American aid in the form of air equipment and in spite of off-shore orders, a "stretch-out" has been found to be just as inevitable as in Britain.

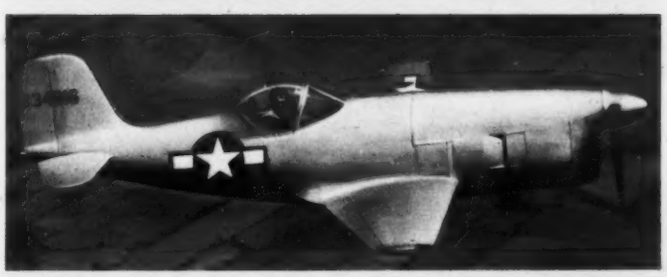
Where aircraft production is concerned (which will absorb nearly half the air credits in the new year) it is obvious that even by turning out its pockets the country cannot make ends meet. From 1936 to 1939, the four years of rearmament preceding World War II, roughly 700,000 million francs (at 1952 values) were devoted to the aircraft industry, a sum which was not equalled during the seven years following the close of hostilities. At that time aircraft were on an average ten to twenty times less costly than they are now. Yet in spite of the production and financial effort made before the war, and although the German offensive of 1940 forestalled the full deployment of production in France, these funds were inadequate. Whereas France spent 300,000 million francs (at pre-war values) on her armed forces between the two wars, the Third Reich spent 550,000 millions between 1934 and 1939.

History shows that shortage of money can have disastrous results for nations. Today for example the credits corresponding to those of twelve years ago will buy only 8 to 10 % of the arms bought then. It is therefore becoming universally recognized that the West's grey matter should perhaps be used to find weapons more suited to the funds which can reasonably be provided to purchase and operate them in sufficient quantity. This is undoubtedly one of the major lessons of the past year.

The machine is overpowering man

The second lesson concerns man and not the machine. The heads of Air Training Command recognize that to "supply" 1000 first-rate pilots to the U.S. Air Force's operational units they must have 12,429 physically fit candidates to choose from. To become captain of a B-47 six-jet bomber a pilot must have completed 2,500 hours of flight, or at least 1,500 if these include 300 at the controls of a B-45 or B-47. The training of maintenance personnel is equally complicated. The K.1 electronic sight, for example, has to be serviced by engineers, not mechanics, even though they have "electronics" or "equipment" certificates. "Air Force" published an article last summer describing the history of the B-47. From 1943 to 1947 Boeing was working out the design, preparing drawings and building prototypes. From 1947 to 1949 it perfected and modified its prototypes. In 1949 it started production, and the first machines were delivered nine years after the design had first been decided upon. Training of the technicians required began in 1948 and of the crews in 1949. It is only now, nearly ten years after Boeing's engineers drew the first sketches of the future B-47, that trained personnel, machines and spares can be assembled in Strategic Air Command's operational units.

As for the efforts demanded of the flying personnel, these too help, if not to reduce recruiting, at least to impose special conditions. "Whatever may be the final outcome of the enquiries in progress," wrote Chief Medical Officer General Bergeret after analysing a number of accidents, "very little is needed, at the speeds of jet aircraft, to affect the pilot's psycho-physiological balance, and hence the safety of the flight . . . Even before the appearance of warning physical symptoms of loss of consciousness, the pilot of a jet aircraft is more exposed than he was in a propeller-driven machine to the slightest relative anoxemia and the effect of repeated accelerations, each of which taken by itself would not be harmful, and finally to the combined action of



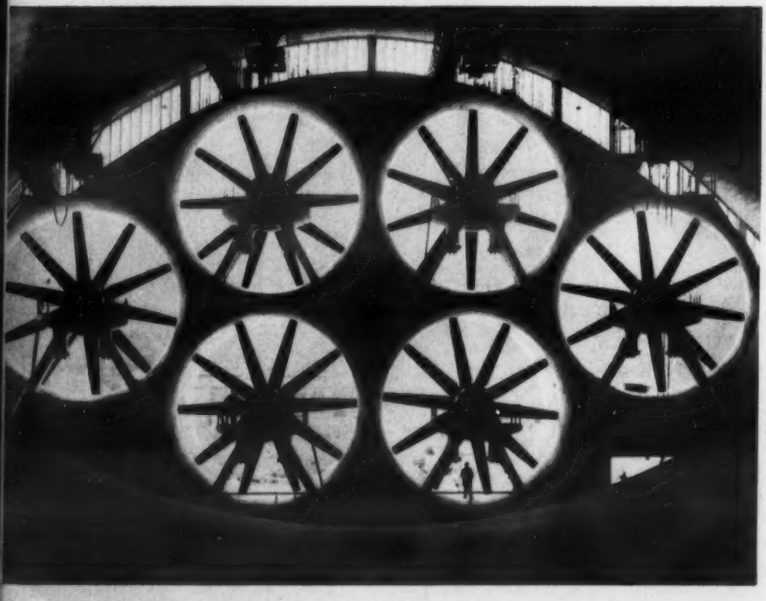
For many years military experts have studied "short-life," "stripped-down" or "expendable" fighters. *Top :* the wooden Miles M-20 stripped-down fighter, the prototype of which was designed and built in *nine weeks* in 1940 ; *centre :* the Bell XP-77 all-wood experimental light-weight fighter (2,650 lbs., against 30,000 lbs. plus of today's all-weather fighter !) designed in 1942 to overcome the threatened aluminium shortage in the USA. Engine : a 575 h.p. Ranger U-770-7 ; *bottom :* jet-propelled short-life fighters were tried during the war by the Germans : picture shows the Heinkel He 162 "Volksjäger," or "People's Fighter"; the Japanese used "inhabited" suicide bombs.— Designers everywhere are continuing their studies. Among these are Boeing, with a design for a stripped "Stratojet" bomber, Folland in England with a stripped fighter.

Savings in expenses on air defence can be achieved by standardizing production types. The U.S. Mutual Security Agency has adopted the principle by delivering the Republic F-84 "Thunderjet" fighter-bomber to various NATO countries.

general and specific causes referred to earlier; and the margin of safety is thus very greatly reduced. The less solidly based his qualities of judgment and concentration are at the outset, the more easily this happens."

Thus it is the financial and the physiological barriers, rather than the technical, which will set a limit to our ambitions. Until power plants are simplified into ramjets, pulse-jets or "resonance pipes"; until electronics are sufficiently advanced to enable the human pilot to be left behind on the ground, together with the array of equipment which he now has to take up with him into space; until the guided missile can carry out certain of the tasks which still devolve on the piloted aircraft, two parallel courses must be followed to increase returns on the money expended on air armaments: simplification of equipment designed on new lines, and an inter-Allied standardization of design and production of aircraft in sufficiently large quantities.

Rationalization and integration of aeronautical research would produce further economies. Duplication of huge installations like the French ONERA's wind tunnel at Chalais-Meudon devours vast quantities of money.



The prototypes brought out these last two years, like the dates fixed for their employment, seem to indicate that scientists and engineers still have time before them to work out interim types before guided missiles replace certain conventional aircraft. Models such as the Convair F-102 and Republic F-103 in the United States, the "Swift," "Hunter" and "Javelin" in Britain and the "Mystère IV" in France will not get into squadron service until 1954 or 1955, and will then continue to be operational for two or three years in their present form, or four or five years more if we consider the life of their direct derivatives. The same doubtless applies to the B-47, B-52, "Valiant" and Avro 698. Covered in this way almost up to the end of the present decade as far as what may be termed conventional aircraft are concerned, designers will probably explore new fields rather than develop the families of equipment which must already be regarded as classical in spite of their increasingly high performance. There can be no doubt that the next two or three years will see the creation of experimental machines to try out a new philosophy based for example on

—the adaptation of certain air weapons to a definite theatre of operations,
—greater specialization of equipment, the inevitable technical compromise being inclined more in one direction or another depending on the task to be filled,
—lightening of the load on the ground organization and the search for mobility and invulnerability of the air arm's ground services,
—increasing integration of the air arm itself in a combined air-ground system of detection, control, counter-measures, supplies and support.

Perhaps too, in spite of the difficulties it entails, there may be general adoption, as a provisional solution, of the light aircraft, simpler in design and maintenance, the principle of which was born in Germany and developed in Russia and has since attracted a number of designers in Britain, France and Poland.

As for the rationalization of Western aeronautical research and production, this will again depend more on the engineers than on the politicians. The latter will undoubtedly find the idea more attractive than the former. The only thing is, there will come a moment when certain countries will find themselves faced with a dilemma; either they will have to give up making flying equipment or else they will have to get together and pool their production resources. One feature of Western Europe is that its production capacity greatly exceeds its consumption, or, in other words, its internal markets. And foreign outlets are not large. Because of the present territorial mosaic overheads are multiplied and aircraft can be produced only in small quantities. Thus not only is production not entirely rational but it is also handicapped by the cost of a technical and scientific backing that is indispensable but impossible to pay for with small production lines. In the matter of aviation all the countries of Western Europe have to make the following choice: either to design prototypes and have insufficient funds for their production in adequate numbers—and Britain is rather in this position—or to produce without the requisite research facilities. If an attempt is made to balance these two activities within each European country, the result will inevitably be two irrational organizations. The experience of the past few years, and particularly of 1952, thus invites us to "rethink" not only the technical problem but also that of aeronautical research and production by moving from the national to the European level.

U.S. Aeronautics in 1953

An outlook on adult aviation's first Republican year

BY CHRIS ROBERTS, WASHINGTON

The United States has met its immediate aircraft production expansion goals and is entering 1953 "levelling out on the plateau," exactly as scheduled. In the future, barring all-out war, the U.S. will maintain its aircraft production at the present rate, sufficient to maintain its Air Power at its present size but not enough adversely to affect the national economy. This, according to the planners, the thinkers and the estimators. If they are wrong—or if a full-scale war occurs—the aircraft and airline industries will be thrown into a turmoil.

The rapid rise in the cost of military aircraft (something like ten times per equivalent aircraft of 1940) since V-J Day has brought the production of such weapons into the area of importance in the national economy. *For the first time in its peacetime history, the U.S. must budget its armament program on the basis of the national economic health and not on armament requirements alone.* While an old and familiar problem to most of the nations of the world, this is a new and frustrating consideration for the richest of all nations.

What will the Republicans do?

This is only one of the varied aviation problems, both military and civil, which the U.S. will have to tackle in 1953. It also happens that the new year *is the first since the coming of age of the airplane, of air transportation and military aviation,* that will be guided by the new Republican Administration.

After twenty years of Democratic party rule, it is inevitable that assumption of control by the Republican party will effect changes also on the aviation scene. The business-like approach of the Republicans to the problems of government are sure to force an overhauling, for example, of the *civil aviation philosophy* of the past twenty years. The Civil Aeronautics Board has felt that its major duty was to "promote" civil aviation in the country, and virtually all of its decisions—profound and minor alike—have been based on the philosophy of service to the public. Although present regulations prohibit much change in this view, the Republicans—over a period of time—seem certain to turn the Board around to a purely regulatory function, with the maintenance of airline business health the over-riding consideration. This means, for example, that if a big airline can serve a community cheaper and more profitably than several small ones, the little ones (or rival big ones, too) will have to go.

The Republican concept of business-like operation of government seems likely, also, to place severe *restraints on the lending of funds abroad for the purchase of U.S. civil aircraft*—thereby relaxing the market for British and French manufacturers. The U.S. has already loaned foreign airlines some $25,000,000 for the purchase of U.S. transports and another $100 million for the purchase of airplanes, parts and equipment through the Mutual Security Agency. Since all of this equipment eventually enters services competitive with U.S. airlines, the theory of such loans is more benevolent than profitable.

In the *"off-shore" buying sphere,* so badly tangled at the moment, the Republican administration should pursue the present course of off-shore procurement of aircraft and equipment for NATO commitments, rather than the direct supply of U.S. aircraft and equipment, the goal being self-sufficiency of the French, Italian and British aircraft industries.

Budget

The Budget for the 1954 fiscal year (which begins on July 1st, 1953) will be established and approved under the old Democratic administration, before the inauguration of the Republican on January 20th. Even so, the new appropriations will contain considerably less money for aircraft procurement than the past three fiscal years. The reason is, as stated above, that the U.S. must now adapt its defense program to the nation's financial resources.

Paradoxically, these reduced funds will produce more delivered aircraft during 1953 than in the preceding three years, since most of the previous funds have gone for the expansion of production facilities, notably tooling for new models.

During 1952 the United States will have produced about 9,000 military aircraft, about 400 civil transports and more than 3,000 personal aircraft, approximately double the output of 1951. More importantly, however, Jan. 1st, 1953 will find the U.S. producing military aircraft at its target rate of about 1,100 per month, or 13,000 to 15,000 during the year.

This military production program will not only complete the build-up to 143 combat wings in the Air Force and 16 carrier air groups in Naval Aviation but will permit re-equipping existing groups with modern aircraft and—barring untowards events—replace combat losses in Korea and operational losses at home and abroad.

The fiscal 1954 defense budget totals about $40,000,000,000, of which $17,000,000,000—the largest item—is for the Air Force. This represents a substantial reduction over the current military budget (which includes $22,000,000,000 for the Air Force).

Aircraft Production

The year 1952 saw the aircraft manufacturing industry all but founder in its own technological revolution, but, at its close, found it fully cognizant of the path out of the wilderness. The explosive increase in complexity of transonic combat aircraft caused a vortex of confusion in the industry. New materials, new processes, new tools, new electronic circuitry, new demands on technical ingenuity—all of these things made 1952 a revolutionary year for the design and production of the modern combat airplane.

As the year drew to a close, it saw a *gathering army of aviation leaders calling for a halt to complexity, demanding incisive judgment on new equipment items*—while meantime re-equipping their plants for the quantity production of such technological paradoxes! Giant presses and extrusion machines, monster milling machines, huge stretch presses—the list of the fabulous new tooling acquired is endless. Titanium, foam plastics, three-dimensional machining, hot forming, new steels, all of these things and more came into production application during the year.

The accelerated application of new techniques to aircraft production reflected not only the increased complexity of the product but a girding for readiness against a future emergency. The program since Korea has been aimed at "expansion of the base" and that expansion is now in the general area of capacity desired. With it has come expansion of production itself, so that today the U.S. aircraft manufacturing industry is on the plateau.

Meanwhile, a number of detail changes occured in the aircraft production picture during 1952 which will have their effects also in years to come. The *Glenn L. Martin Co.* firmly abandoned any future civil transport efforts, after a long and very costly experience with the Martin 2-0-2 and Martin 4-0-4 series. *Northrop* ran into very serious trouble with its F-89 "Scorpion" interceptor late in the year, *Boeing* disclosed plans for its Model 707 four-jet civil transport for 60 to 80 passengers. Prototype tests were promised for 1954 and production airplanes for 1956. Boeing will also offer the model as a high-speed flight refuelling type to the Air Force, and acceptance by the latter seems likely.

Air Transport

Air coach expansion to full partnership with first class travel marked 1952 in the U.S. airline industry, and it was the best of black-ink post-war years. *New equipment* flooded into the airlines during the year, with deliveries of the Convair 340, Martin 4-0-4, Douglas DC-6B and Lockheed 1049 "Super Constellations" getting well under way.

This expansion took place, and will continue at an even expanded rate during 1953, *under the gathering cloud of jet transports.* Long awaited, the first U.S. order for a jet transport (Pan American's contract for the de Havilland "Comet 3") developed little, if any, impact on the industry, despite long predictions to the contrary. Two factors combined to make this long-heralded event impotent: the fact that Pan American has no domestic routes in the U.S. and the fact that U.S. manufacturers—notably Boeing—began making firm motions towards the creation of a U.S. jet transport. However, major U.S. airlines continued generally bearish on the subject, while they wrestled with financing for the hundreds of piston-engined transports they now have on order. *It still looks like 1958—at the earliest—for a domestic U.S. jet transport service.*

A trend which will continue throughout 1953 was inaugurated late last year, against strenuous initial opposition, by United Air Lines with its decision to turn away from the crowded 66-passenger interior of the "coach" version of the Douglas DC-4 in favour of only 54 seats. This indicates that the airlines are beginning to *abandon the illusion of "tourist class" in favour of the honest admission that "low fare" should be the character of standard airline service.* Thus, reduced fares without major reduction in comfort will characterize U.S. airlines during 1953. (*Editor's Note:* Read what a foremost French expert, Air France Director-General Henri Ziegler, has to say on the subject: *"Thoughts on the Evolution of Civil Air Transport,"* in this issue.)

The problem of airline service charges for the use of Federal facilities (airways, airports, etc.) will be thoroughly aired under the business-like Republicans and a pattern of such charges should emerge during the year, despite vehement airline opposition.

Research Results

The ample funds available to the military since the outbreak of hostilities in Korea are beginning to bear prototype fruit. The Douglas XA3D-1 twin-jet carrier attack plane and the Douglas X-3 supersonic research airplane (fastest man-carrying vehicle in history) have completed their first test flights in California. Navy has revealed that the Convair XF2Y-1 fighter features a hydro-ski installation. It will fly early in 1953 and go far towards making the dream of a water-based fighter a practical reality. The Lockheed R7V-1—Wright-turbo-compound version of the "Super Constellation" has flown, as has the first production Republic F-84F swept-wing version of the "Thunderjet." Scheduled to fly during 1953 are the Boeing B-47C "Stratojet" (four-jet version), the Martin B-57A version of the "Canberra," the big, new North American F-100 "Super-Sabre," the McDonnell F-101 escort jet fighter, the Convair F-102 delta-wing fighter, the new Lockheed C-130 high-wing, turboprop transport and the big Piasecki XH-16 transport helicopter.

Guided Missiles

Guided missile output, shrouded in deepest secrecy in the U.S., is now well into the quantity production stage, with Martin, Convair, North American, Northrop, Vought, Fairchild, McDonnell, Douglas and Bell already producing missiles in quantity. The program, one of the most vehemently debated in recent years, is showing definite signs of fruit after six years of lavish expenditure. Already in operational use are anti-aircraft missiles, and air-to-air missiles are being produced in quantity. Present forms of the ground-to-ground missiles are developmental only, and the navigational problems over substantial ranges (500 miles or more) are proving insurmountable at the present.

Private Flying

The personal plane business continued its upswing during the year but, more than ever, in the four-place-and-up business or "utility" plane models—not the two-place pleasure or sport models. Having halved its previous year's production for five straight years following V-J Day, the personal aircraft industry held its own in 1951 and made a gain of about 25 percent last year. Crop dusting, business travel and executive use seem the present and future tasks of the lightplane in the U.S., and pessimists insist that the golden days of sport flying and instruction are now dead for good.

War in Korea and "Short-Life Aircraft"

In Korea, the U.S. now has a very powerful Air Force of the most up-to-date equipment. Even later equipment will be sent to Korea during 1953 to provide operational experience, with the Boeing B-47 being the most-mentioned candidate. (Fear of loss of such a plane has been—and continues to be—the hold-up on the project.) Also due for Korean action is the Grumman F9F-6 swept-wing "Cougar" and the North American F-86D all-weather "Sabre."

But one of the major problems remains unsolved. The mounting unrest over the complexity of modern combat aircraft will increase during 1953 and probably result in the creation of *"light weight" fighters and "stripped" versions of current types,* such as the B-47. (*Editorial Note:* "INTERAVIA Review," and especially its regular contributor, Colonel Pierre Gallois, of the French Air Staff, have long stressed the imperative necessity of cheap short-life or even "expendable" combat aircraft.—See Colonel Gallois' article in this issue.)

*

As a general trend for 1953 it is to be expected that mounting conflicts between the military air services and commercial air transport will become more pronounced. However, the military dominance over everything in the USA at the moment cannot be neutralized unless some great stride is made towards international peace during the year.

And that is the avowed dedication of President-elect Eisenhower: All Americans, Democrats and Republicans alike, hope that he can be successful in helping to cure the gravest of the world's ills.

After that—everything else will be simple.

Wing Shapes

What's in a Shape ?—Straight, Swept or Delta ?

BY SCHOLER BANGS

In a nation which delights in superlatives there is a strong feeling that serious exploration of a controversy, any controversy, should be productive of far-reaching, decisive conclusions.

One might be expected, as an American, to leap boldly into the midst of the international wing shapes melee and emerge triumphant, pronouncing that the swept, the delta or the straight wing is tomorrow's wing of supersonic destiny.

Certainly the stage setting for such a venture has never been more ideal than it is today on the West Coast of the United States, where airframe manufacturers responsible for the bulk of their nation's military production now have declared their wing shape preferences in seeking orders for future supersonic fighters and bombers.

Until quite recently there was no clear definition of the reaction of the aircraft industry, at least in the United States, to wing shape trends.

Immediately after World War II a casual observer of the United States aviation scene easily could have been led to wonder whether the aircraft industry fostered technical advances or was simply responsive to popular enthusiasms for "something new."

The aviation-minded American populace was all for immediate junking of piston-engined aircraft as the first jets made appearance. Similarly, when the first Sabre fighters began arrowing through the sky in public view, Americans were left dazzled and breathless by the prospect of aviation's swept wing future. When the word got around that the British might go delta, doubt and anxiety assailed many American aviation planners. Only recently have they been made to feel more at ease by initial military orders for delta wing fighters of Convair and Douglas design.

Last year, just as American military experts and Congressional guardians of national spending were convinced that they would have to judge between only two basic configurations, the delta and swept wing types, in handing out appropriations for truly supersonic fighters, they were jolted by what amounted to an engineering earthquake. Its epicenter was within a large segment of the United States airframe industry ; the group of airplane builders who seemingly had been caught short by indecision and failure to swing their designs either toward delta or sweep. In a press conference designed to produce nation-wide radio broadcasts and newspaper and trade magazine headlines, a key member of this group declared that his company would bet on the old-fashion straight wing for support of their forthcoming supersonic fighters !

A more dramatic situation could not have been asked to force, seemingly, a conclusive proving of the supersonic merits of three sharply contrasted wing shapes.

Scholer Bangs (left), INTERAVIA's West Coast correspondent, who suggested this symposium on wing shapes, having Convair hydrodynamicist Ernest G. Stout describe to him the model of a twin-jet delta-wing supersonic flying boat (forerunner of the Convair XF2Y-1?).

It is something of a strain upon credulity to see such radical differences in wing shape philosophy materializing today on the production floors of West Coast plane builders who, geographically and in their ability to exchange research information, might be said to be living in the same house.

Boeing and North American definitely are disciples of the swept wing. Convair's supersonic future appears to have been staked on the delta. Lockheed and Northrop are committed to the straight, thin wing. And Douglas is in business with all three shapes.

Here, it would appear, might be a perfect setup for determining a trend, if not a final answer, indicating the shape of the wing most likely to survive in the final throes of competition.

It may be disappointing to some to learn that I was utterly unsuccessful in my own fairly extensive search for "the answer."

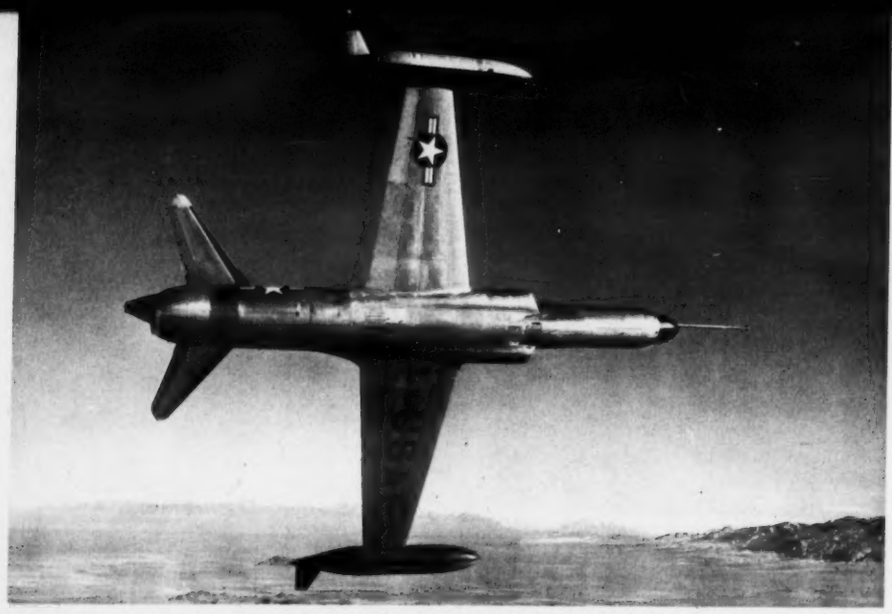
There was a measure of satisfaction, however, in discovering that others, far better equipped for such critical probing of a touchy subject, have been equally unsuccessful. Upon a number of occasions the Society of Automotive Engineers, and the Institute of The Aeronautical Sciences, have invited to engineering conferences the representatives of companies supporting the various wing shapes. In none of these meetings have any acceptably decisive conclusions been revealed.

In personal conversations with engineering heads of these West Coast companies, and attending a recent IAS discussion of wing shapes, it became apparent that a satisfactory settlement of the "Which Is Best ?" debate may not be realized until all sides have their favored designs in production and in actual flight competition.

Aerodynamic attributes of swept, delta and straight winged aircraft are fairly well established, and were it not for the current imposition of military security upon the very latest research data affecting all types it might be possible to cite one specific shape as the most promising.

However this approach falls apart in recognizing many incidental factors which subtend aerodynamic considerations.

From straight to swept wing : The Boeing B-17 "Flying Fortress" "heavy" bomber of World War II and its modern counterpart, the Boeing B-52 "Superfortress." In ten years maximum speed of bombers has risen from 290 m.p.h. (B-17) to 600 m.p.h. (B-52), and range from 1,100 miles (with 6,000 lbs. of bombs) to about 8,000 miles (with 10,000 lbs. of bombs).



From swept to straight wing : After a brief interval, with the sharply swept XF-90, Lockheed returned in the F-94 "Starfire" all-weather two-seater fighter to the very thin straight wing. However the tail unit has not yet been able to escape from the swept form . . .

Wing Shapes

A review of the design and production trends of the West Coast companies, since the end of World War II, is highly suggestive of why Boeing and North American are swept wing enthusiasts ; why Lockheed and Northrop beat the drum for the supersonic possibilities of the straight wing. Douglas, it would seem, is in the fortunate position of having gained, through canny acquisition of high-speed research plane contracts, considerable primary production experience and a wealth of practical aerodynamic knowledge covering all three wing shapes. This company doubtless feels itself ready to concentrate upon any particular shape which, during the coming months, may display marked superiority in flight and possess greatest sales appeal in military procurement offices. Convair, with no fighter types in production directly after the war, and its B-36 bomber now obsolescent, has been peculiarly free to explore and then adopt the delta shape for its supersonic gamble.

From the foregoing may be gained an appreciation of the difficulties confronting any attempt to evaluate, with any measure of finality, wing shape merits.

A suggestion that the several shapes may fall into given ranges of supersonic performance, and gain for their sponsors profitable orders for aircraft which will have a long production life in meeting various tactical requirements, was followed up with negative results.

Manufacturers are extremely reticent in revealing data which might isolate performance ranges for their favored wing shapes. Some insist, and probably with accurate honesty, that their very latest data is under secrecy restriction. Others, and this is quite understandable, admit quite frankly that they do not want to give away data which may be used shortly by their military sales staffs to seek experimental and production contracts in competition with companies using similar or even differing wing shapes.

As a result, *Interavia's* invitation to the West Coast group of manufacturers to participate in a wing shapes symposium brought interesting reactions.

Some companies were willing that their aerodynamicists submit signed and moderately technical papers on the subject. Convair chose to present its case for the delta shape without an author's credit line, indicating that the text generally expresses a company-approved merging of the findings of several of its foremost aerodynamicists. Other companies preferred that their specific technical data be obscured, and that their position in support of chosen shapes be represented broadly on the basis of interviews with engineers and administrative officers.

Interavia believes that the resultant observations on ensuing pages nevertheless will maintain the effect of a formal symposium, and the discriminating reader may be able, from his or her personal knowledge, to sense answers to the basic question: "Which wing?"

In recent engineering conferences on the Coast there has been a notable tendency to concede that the straight and thin wing may be the wing for very high speeds. It is interesting to note, in this respect, that Douglas, after reviewing a wide variety of wing configurations, and having at hand considerable data from high speed flight tests of straight and swept wings mounted on its "Skystreak" and "Skyrocket" research craft, decided upon a stubby straight wing for its X-3, now undergoing preliminary flight tests at Edwards Air Force Base.

Let us suppose that the straight wing may prove to be the best for very high speeds ; speeds beginning at 1000 m.p.h. and possibly rising to 2000 m.p.h. or faster. How soon will we have the power to produce speeds requiring, imperatively, the use of such a wing ?

It seems reasonable to believe that until we have turbojets with thrust considerably in excess of that offered by the latest models now being tested ; large, reliable ramjets ; or rocket systems suited to tactical application, the wing for very high speed will have to poke along for an indefinite period in a region between high subsonic and Mach 1.5.

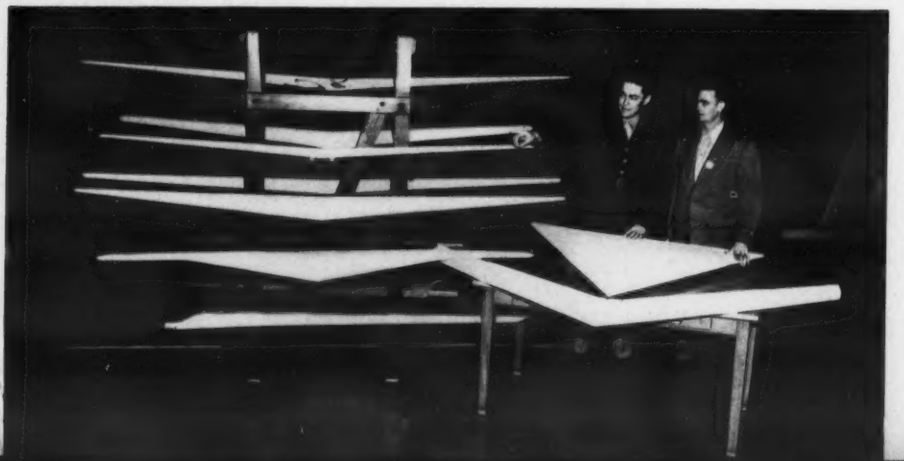
In this performance range there seems to be no clear-cut index of wing shape superiority. Under a given set of conditions one wing shape may display a dominance which may very well be lost to a competitor shape when the two are tested under a differing set of conditions.

Nor can it be said that aerodynamic excellence will suggest the wing shape most likely to graduate cum laude from the College of Supersonics. The graduate wing will have had to score outstanding marks in several associated courses as well.

How quickly can a given wing shape, applied to a new supersonic fighter, be placed in production ? Does it lend itself to a competitive production rate ? What space limitations will it impose, contrasted with competitor shapes, for the stowage of fuel, armament, radar, landing gear and the various accessories of high speed flight ? And, most important questions that a manufacturer is bound to ask in practical self-interest : "Is it a shape which can be developed most easily, with minimum risk, using the specialized knowledge accumulated in my engineering department ? How seriously will it disrupt my present production ; to what extent will it involve a costly switch in tooling and re-training of production personnel, to get this new plane rolling out the door ?"

Aerodynamicists unhappily concede, privately, that these incidental considerations, and sometimes others as well, are likely to impose design concessions ranging from minor to serious.

Which wing? Even the aerodynamicists cannot answer this question yet, much less the military. Group of airfoils in Boeing's wind tunnel model room.



An Engineering Comparison Using Straight, Swept, and Delta Wings

BY K. E. VAN EVERY, CHIEF, AERODYNAMICS SECTION, DOUGLAS AIRCRAFT COMPANY, INC., EL SEGUNDO DIVISION

The following discussion by K. E. Van Every without doubt will stand as a memorable effort to present analytically the essential merits of swept, straight and delta wings. Without serious variation, the author has presented his views to limited audiences of West Coast engineers in sectional meetings of the Society of Automotive Engineers and Institute of the Aeronautical Sciences. The technical data he offers come attractively close to that covered by security classifications. To our knowledge, Mr. Van Every is the only United States authority, directly associated with a manufacturing concern, who has attempted a comparison of the three shapes. As might be expected, others in the United States disagree with him on some points; and there can be little doubt that his paper will arouse stimulating divergence of opinions among those who read it.

THE EDITORS

Introduction

Although every aerodynamicist insists that wing planform is very important for airplanes designed to fly supersonically, examination of the geometric characteristics of currently proposed high-speed designs shows that there is a great deal of confusion on this subject. In fairness to the aerodynamicists it must be said that each may be correct in his planform choice if the type of airplane and its mission, limitations imposed by structural considerations, manufacturing, maintenance, etc., are all carefully considered in making the best design compromise. Thus for certain types of aircraft that must reach extremely high Mach numbers, a thin-straight-wing airplane configuration may be the most suitable. For slightly lower Mach numbers in short-range missions, a delta-type configuration may offer the most promise; and for the case where the supersonic Mach number is limited to 1.5 or less and long range is desired, a conventional sweptback-wing arrangement may be chosen.

Before comparing hypothetical airplanes of these types, it seems advisable to discuss, in general terms, the aerodynamic means available for reducing drag in the various speed ranges. Emphasis is placed on speed as the primary requirement of a fighter-type airplane, since a speed advantage is always necessary if an airplane of this type is to perform its basic mission effectively. For slower airplanes such as transports and light planes the main factor in determining the high speed is simply the parasite or ordinary low-speed drag as shown in Figure 1.

(Following page 24)

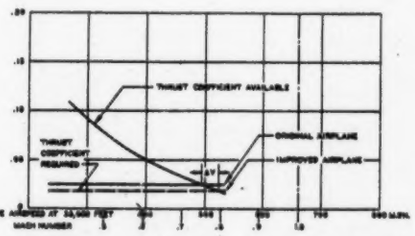


Fig. 1: Speed gain ΔV (Mach number and true airspeed at 35,000 ft.) by reducing low-speed drag. Maximum speed obtainable is found at the intersection of the curves of thrust coefficient available and thrust coefficient required.

"Cracker Barrel Philosopher" on Wing Shape Dispute

In the United States there is recurrent appreciation of the wisdom of The Cracker Barrel Philosopher. As typically American as baseball, he is seen most commonly as the village sage who holds council beside the cracker barrel in a little country store. Invariably his simple, often trite observations bring into sharp focus a truth obscured within a litter of confused thinking.

Interavia's West Coast representative found him surprisingly alert when confronted with the problem of trying to determine which one of the basic supersonic wings is most likely to endure.

The old philosopher let his corncob pipe grow cold as he studied the writings of the experts.

"Right pretty flyin' machines. Ought to go mighty fast," was his reaction to photographs of the swept wing fighters and bombers.

The delta drew a snort of irritation. "Leave it to them Greeks to toss in a new-fangled contraption like this. But, I guess it'll fly if your smart young engineers say so."

It was the report that some American plane builders are gambling on the simple, straight wing as claimant for tomorrow's supersonic honours that really aroused him.

"Now why in tarnation did they have to spend all that money on high-priced engineers to come up with that! There's your wing! There aint no gettin' around it!"

Our West Coast representative asked him how he could be so certain.

"Now look," the philosopher of the cracker barrel replied. "I wasn't born just yesterday. Been watching these flyin' machines in one form and another for quite a spell. And I've been seeing it happen over and over again.

"Take those early day airplanes as a starter. The bright boys in engineering figgered their tricycle landing gears were a might old-fashion, I guess. But today, a bit smarter I hope, we're right back to the tricycle landing wheels. Same say with making them go. It wasn't new enough to have the propeller in back, pushin'. They had to hang it out front, on the nose. And now we're right back where we started, a-pushin' the airplanes in the tail—with jets, of course.

"I recall there was quite a to-do a while back over putting a controllable stabilizer on the tail. Seems it was a big deal to keep planes from getting out of hand around the speed of sound. Whoever thought that one up must have been reading up on some of the controllable tail surface planes the Europeans were messing with long about the start of World War I, or before.

"And wasn't it the Wright brothers who used to fly their first airplane lying flat on their bellies?"

The philosopher paused to re-light his pipe, and handed back the weighty bundle of engineering reports, the straight wing comments on the top of the pile.

"You just mark my words, young feller. The old ways are best!"

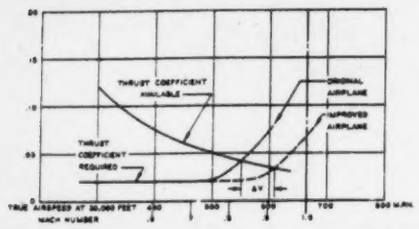


Fig. 2 : Speed gain ΔV (Mach number and true airspeed at 35,000 feet) by increasing critical Mach number. Maximum speed obtainable is found at the intersection of the curves of thrust coefficient available and thrust coefficient required.

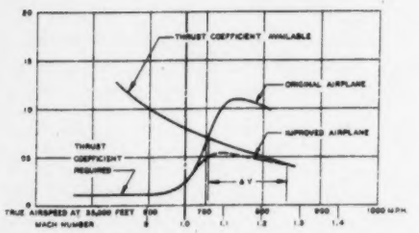


Fig. 3 : Speed gain ΔV (Mach number and true airspeed at 35,000 feet) by lowering drag peak. Maximum speed obtainable is found at the intersection of the curves of thrust coefficient available and thrust coefficient required.

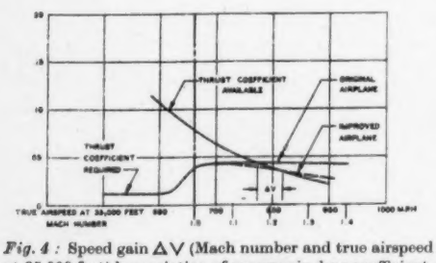


Fig. 4 : Speed gain ΔV (Mach number and true airspeed at 35,000 feet) by variation of supersonic drag coefficient. Maximum speed obtainable is found at the intersection of the curves of thrust coefficient available and thrust coefficient required.

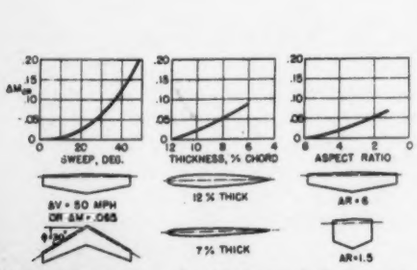
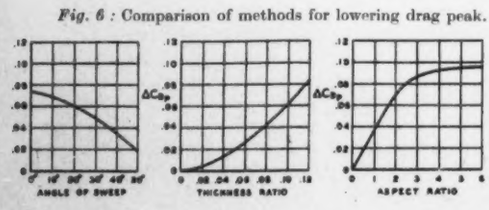


Fig. 5 : Comparison of methods for increasing wing critical Mach number (ΔM_{CR}).

Fig. 6 : Comparison of methods for lowering drag peak.



For airplanes having high speeds slightly less than Mach number 1.0, the gains in performance can be achieved by increasing the airplane critical Mach number, or more exactly, the Mach number at which the drag rise occurs. This is illustrated in Figure 2. Even supersonic airplanes should have a high critical Mach number, since much of the time they must fly at subsonic speeds in order to make the most efficient use of their fuel.

If we set our sights somewhat higher and ask for supersonic level-flight speeds, it is then necessary either to lower the peak drag coefficient, which occurs near Mach number 1.0, or to obtain increased engine thrust. Obviously, there is a limit to engine size, and it therefore becomes necessary to lower the peak drag. The increase in maximum speed that can be achieved by this means is shown in Figure 3.

If extremely high supersonic speeds are desired, that is, greater than M = 1.2, the variation of drag coefficient with supersonic Mach number is the important consideration. This variation, shown in Figure 4, is influenced by the type of planform and the airfoil section.

Thus, it is seen that for high-speed performance it is first of all necessary to devise an airplane configuration that will have the highest possible critical Mach number; second, if still higher performance is desired, the lowest peak drag coefficient; and third, if extremely high supersonic speeds are desired, decreasing drag coefficient in the supersonic region. Fortunately, the increase of airplane critical Mach number and lowering of airplane drag peak are achieved by the same three basic methods. These methods are illustrated in the next two figures. Figure 5 shows that the critical Mach number may be increased by the use of sweep, thinner airfoils, and lower aspect ratios.

Other means for increasing airplane critical Mach number, which are not shown in this figure, are combining components, such as wing, fuselage, tail surfaces, canopy, etc., in an optimum manner and the use of boundary-layer control. The drag-peak variation with sweep, thickness ratio, and aspect ratio is shown in the next figure (6). In both figures, it is seen that sweepback and reduced thickness are very powerful means of changing the airplane high-speed characteristics. Low aspect ratio is directly beneficial to some extent, but as will be discussed later, its major importance is in making possible reduced airfoil thickness.

From this discussion it is apparent that an airplane designed to fly at high speeds can have widely different geometric characteristics, and it is only by considering all of the factors involved, including the operating-speed range, that the optimum airplane can be determined. In order to investigate briefly all the possibilities, three different, typical wing planforms

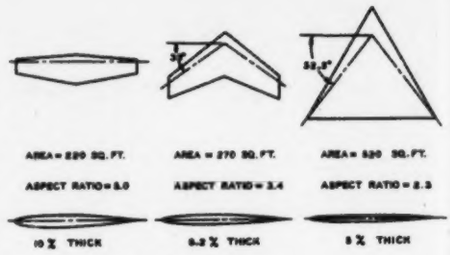


Fig. 7 : Wing planform diagrams.

have been selected and airplanes designed around them—all for the same basic mission and using consistent assumptions as to aerodynamic characteristics.

As a preliminary to discussion of complete airplane characteristics, it appears advisable to consider the characteristics of typical wing planforms shown in Figure 7.

Three types of planform are considered—a straight wing, a sweptback wing, and a delta wing. The straight wing has an aspect ratio of 5, and the swept wing is derived from it by rotating the wing panels 35-degrees. This results in an aspect ratio of 3.4. The delta-wing configuration is a true equilateral triangle, which has an aspect ratio of 2.3. The areas of the different planforms are adjusted so that all of the airplanes have approximately constant stalling speed of 100 knots if the airplane gross weights are constant at approximately 15,000 pounds. Now assuming for a minute that thickness ratio and area are constant, the drag characteristics are as shown in Figure 8.

These curves show that from a drag coefficient standpoint the delta wing is distinctly better than either of the other two planforms. It must be remembered, however, that if the airplanes are to have comparable stalling speeds and take-off distances the wing areas will be different. The straight wing will be smallest, the swept wing somewhat larger, and the delta wing will be nearly twice as large as the swept wing. Thus, if the product of drag coefficient and wing area is considered, the increased wing area will tend to cancel the advantages of the lowered drag coefficient. The problem, however, is complicated even more by the fact that it is possible to use smaller airfoil thickness ratios as structural span is reduced, without incurring a weight penalty. It is obvious that the ratio of structural span to maximum wing-root thickness is the same for the straight wing and the swept wing, but the percent airfoil thickness in the direction of flight is thinner for the swept wing. For the delta wing this same ratio is obtained if the wing-root thickness is approximately five percent. It should be pointed out, however, that other considerations such as torsional deflections and manufacturing difficulties also require a thickness ratio of approximately five percent in order to make the design feasible. (See Figure 7.)

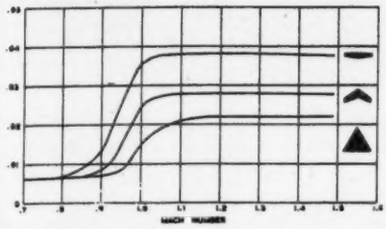


Fig. 8 : Drag coefficient versus Mach number for the planforms shown in fig. 7. Constant airfoil thickness.

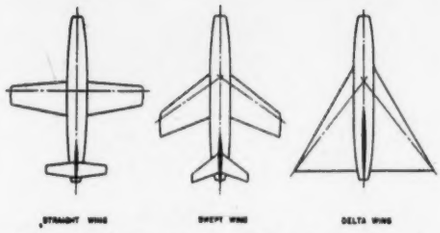


Fig. 9 : Complete airplane planforms for the wing planforms shown in fig. 7.

With the wing characteristics thus defined and the same fuselage for all the airplanes and if the airplanes are to have approximately the same flying characteristics and to perform the same basic mission, the resulting gross weights are nearly constant. Sketches of the complete configurations are shown in Figure 9.

An indication of the high-speed capabilities at 35,000 feet is shown in graphical form in Figure 10. It is apparent that only the delta configuration shows promise of supersonic speeds.

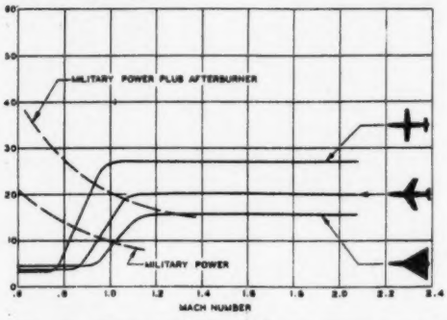


Fig. 10 : Thrust available (C_DS) and thrust required (T/q) for the aircraft in fig. 9.

Handling characteristics

Next of importance after the desired performance characteristics have been obtained are the airplane handling characteristics.

Longitudinal stability

The static longitudinal characteristics are very little different for the straight and swept-wing airplanes in the low-speed region and at low angles of attack. An essential difference between the delta wing and the two airplanes having horizontal tail surfaces is that it is not possible to maintain a high value of static-stability margin and center-of-gravity travel because of the limited trimming power of the longitudinal control surfaces. For example, if the same degree of static stability is provided in the delta wing as in the other two types of airplane, the usable maximum lift coefficient is reduced considerably.

Variation of static stability with Mach number (Figure 11) is most pronounced for the straight-wing airplane. The stability usually tends to decrease as the airplane approaches its critical Mach number, then increase rapidly in the transonic region, and remain high at supersonic speeds. This large change in stability complicates the problem of control of supersonic airplanes and makes irreversible power controls almost a necessity if maneuverability is to be maintained at these speeds.

The sweptback-wing airplane exhibits a similar trend of increased stability just below Mach number 1.0, but usually fails to develop any loss in stability at high subsonic speeds. The increase with Mach number is somewhat more gradual and of somewhat smaller magnitude than that of a straight wing. Both of these effects occur because a portion of the swept wing is always operating subsonically, even though the airplane speeds are supersonic. The delta-wing airplane shows the most gradual change in stability with changing speed, but even here the stability at supersonic speeds is several times that at subsonic speeds.

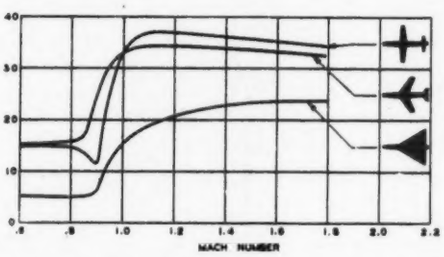


Fig. 11 : Longitudinal stability characteristics versus Mach number for aircraft in fig. 9.

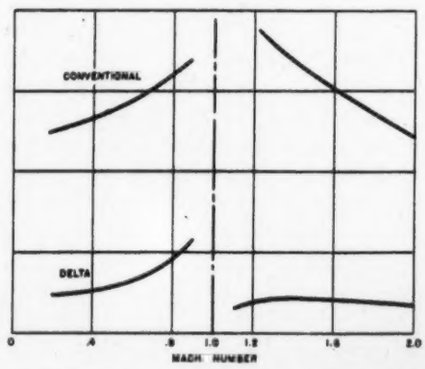


Fig. 12 : Damping characteristics versus Mach number. Conventional aircraft (with tail surfaces) have better damping than deltas.

Dynamic-longitudinal stability

One of the important differences between conventional airplane configurations with horizontal tails, such as either the straight or swept-back wing configuration under consideration, and the delta type is that the conventional type actually increases longitudinal damping in the vicinity of Mach number 1.0, whereas the delta configuration tends to show a region of reduced damping at slightly supersonic Mach numbers. (Figure 12.)

Although this condition is not known to be dangerous, it would have an adverse effect on the utility of the airplane as a gun platform or sighting station. Of course, cures for this type of trouble can be effected by the use of a longitudinal-pitch damper, to check longitudinal motions.

Lateral-directional characteristics

Although objectionable lateral-directional characteristics or "dutch roll" oscillations may occur in any of the airplane configurations under consideration, the use of the swept or delta-type wing tends to aggravate this type of oscillation. The reason for this is shown in Figures 13 and 14. The first of these shows that a straight-wing airplane has no variation in effective dihedral with lift coefficient, thereby making it possible to fit the configuration for a small amount of positive dihedral at high speeds and retain the effective dihedral throughout the speed range. In contrast, both the sweptback-wing and delta-wing airplanes exhibit a large increase in effective dihedral with lift coefficient. Thus, if a small effective dihedral is shown at high speeds, the effective dihedral at high lift coefficient or low speeds, or even high speed at high altitude, disturbs the normal relation between effective dihedral and directional stability.

Fig. 13 : Effective dihedral versus lift coefficient.

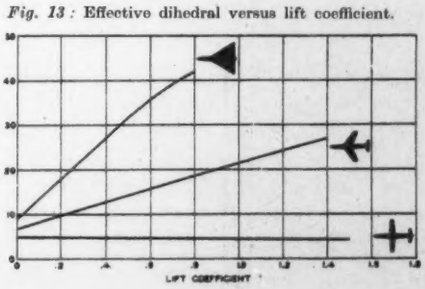
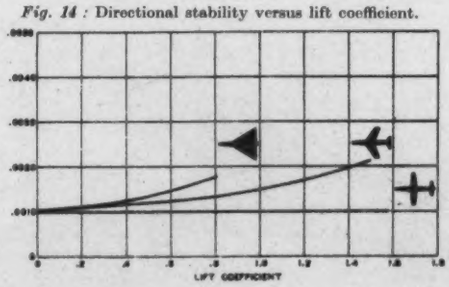


Fig. 14 : Directional stability versus lift coefficient.



Wing Shapes

Although the seriousness of the problem of lateral-directional oscillations can be minimized by proper choice of a configuration, conflicting requirements may make these choices impossible. Items that may improve the situation however, are minimum value for wing incidence, low-wing configuration, etc.

For most high-speed airplanes, it is necessary to resort to the use of a mechanical device known as a yaw damper, which essentially consists of a rate gyro that transmits a signal to a servo that operates the rudder in a direction such as to oppose the yawing motion.

Lateral-control characteristics

At low speeds lateral-control characteristics of a sweptback-wing airplane are generally poorer than those of a straight-wing airplane and about the same as those of a delta wing. At high speeds the delta wing's superiority is due to smaller wing twist.

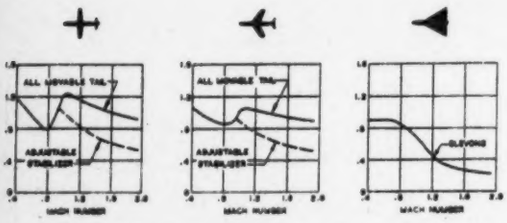


Fig. 15 : Maximum lift coefficient versus Mach number.

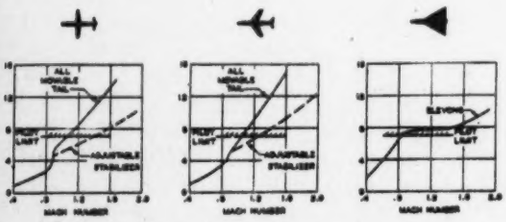


Fig. 16 : Load factor versus Mach number.

A straight wing is featured by the first experimental aircraft for the transonic range, the Douglas D-558 "Skystreak," developed in 1945 on behalf of the U.S. Navy. Max. speed : 1030 km/hr (world record in August 1947).

Swept wing in the Douglas D-558-2 "Skyrocket" rocket-powered research aircraft in which Bill Bridgeman reached a maximum speed of 1238 m.p.h. in 1951.

Maneuvering characteristics

Variation of usable maximum lift coefficient with Mach number

The usable maximum lift characteristics differ considerably for the different airplane configurations as shown in Figure 15. In general, the straight wing has the highest maximum lift at low speeds but exhibits the most rapid fall off with Mach number up to a value somewhat less than M = 1. The maximum lift coefficient then increases to its highest value just above Mach number 1.0 and then decreases gradually. In the supersonic region the highest value is obtainable only if the airplane is equipped with an all-movable horizontal tail surface. Considerable trouble is experienced in attaining maximum lift if only adjustable stabilizer and elevators are available. The maximum lift coefficient of the swept-wing airplane is somewhat lower than that of the straight-wing airplane at low Mach numbers ; it increases at low supersonic Mach numbers and then decreases gradually with Mach number. Here again, the maximum values are obtainable only with all-movable horizontal tail surfaces. The delta-wing airplane maintains a constant value of maximum lift coefficient throughout the major portion of the subsonic range, primarily because the maximum usable lift coefficient is determined by the trimming power of the longitudinal control surface. This deficiency in trimming power results in the smallest value of maximum lift coefficient of all three configurations throughout almost the entire speed range. Fortunately, the lower wing loading of the delta wing compensates for the lower value of maximum lift coefficient. Therefore for maneuvers in the transonic and supersonic ranges it is superior to the conventional airplanes. The load factors developed during maneuvers using these maximum lift coefficients are shown in Figure 16.

Low-speed characteristics

Longitudinal stability at the stall

One of the main problems of the sweptback configurations is that of obtaining a high value of maximum lift coefficient with flaps down, yet maintaining sufficient longitudinal stability so that the airplane will pitch down at the stall. The most effective method of solving this problem on swept-wing airplanes is to use leading-edge slats. This is usually not necessary on a delta-type configuration because of the very low aspect ratio and resultant three-dimensional flow around the tips. In fact, in a delta-wing configuration it is possible to modify the longitudinal stability at the stall by means of suitable small changes in planform.

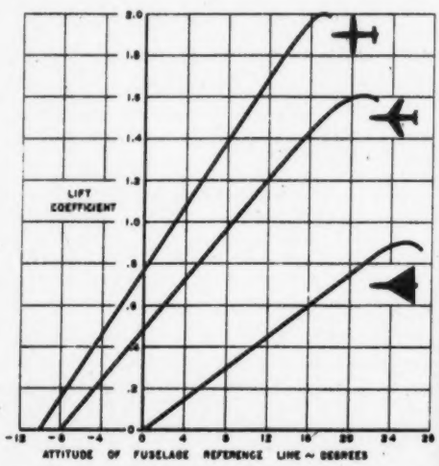
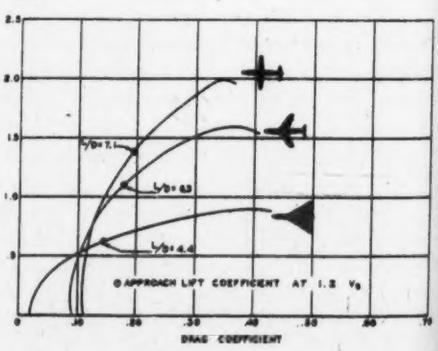


Fig. 17 : Lift coefficient versus attitude of fuselage reference line (in degrees) to landing runway.

Fig. 18 : Comparison of airplane polars (lift coefficient versus drag coefficient). The straight wing has an approach lift coefficient of 7.1, the swept wing of 6.3 and the delta of only 4.4. On the other hand minimum drag near the ground, of vital importance in high-speed flight, is by far the lowest in the delta-wing aircraft.



And as mentioned in the discussion of static-longitudinal stability, it is important to maintain a small but adequate static-stability margin in order to achieve the highest possible value of maximum lift coefficient.

Take-off and approach attitude

The very low lift-curve slope for the swept and delta configurations requires a high-nose-up attitude to attain maximum lift coefficient. (Figure 17.)

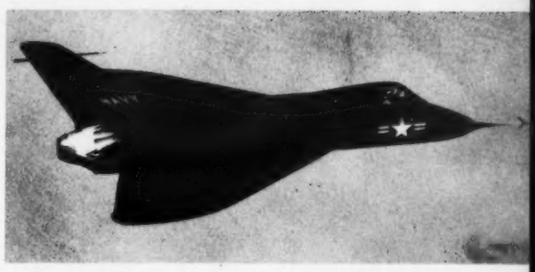
In the case of delta-wing airplanes, on which the use of landing flaps is impracticable, the situation is even worse. The required large increase in angle of attack makes the problem of visibility over the airplane nose a serious one and one that may be reflected in configuration changes that increase the drag at high speeds. For example, it requires the canopy to be placed far forward on the fuselage. The use of a high amount of wing incidence would, of course, be beneficial for this difficulty, but it aggravates dutch-roll oscillation during approach.

Sinking speed

The use of sweep and low aspect ratio automatically produces an increase in drag for a given lift coefficient at the speeds for approach and landing. (Figure 18.) The result is higher sinking speeds and more difficulty in flaring during the landing procedure. This difference in landing characteristics may cause the pilot some concern. Probably the solution to this problem is to train the pilots to become accustomed to these new characteristics and to advocate the use of approach speeds somewhat higher than those now used.

Summary

To summarize, it can be concluded that although it is impossible to select one planform for all high-speed application, the swept and delta configurations offer speed advantages in the lower transonic range, and the delta offers the best possibility of achieving supersonic speeds with a given power plant. At very high supersonic speeds a thin, low-aspect ratio, straight wing may have some advantages.



A delta wing was fitted to the U.S. Navy's Douglas F4D "Skyray" carrier-based sonic interceptor fighter. (Douglas's latest supersonic research aircraft, the X-3 built for the U.S. Air Force, again has unswept wings.)

With regard to handling characteristics, it is generally possible to make a relatively simple control system for the conventional straight-wing or swept-wing airplane, which employs a horizontal tail. The delta-wing airplane invariably requires the use of the more complex irreversible power controls. Some of the questions on the relative merits of the configuration studied will be answered only by flight tests.

Spreiter, John R.: "Similarity Laws for Transonic Flow About Wings of Finite Span." NACA TN 2273, 1951.

John V. Becker: "Characteristics of Wing Sections at Transonic Speeds." University Conference Report, 1951. Pg. 127, Figure 4.

Weaver, John: "Method of Wind Tunnel Testing Through the Transonic Range." Journal of the Aerodynamic Sciences, January 1948.

Van Every, K. E.: "Aerodynamic Considerations in Sweptback Wing Designs." Presented at the Los Angeles Institute of Aeronautical Sciences meeting of March, 1947.

Ribner, Herbert S. and Malvestuto, Frank S. Jr.: "Stability Derivatives of Triangular Wings at Supersonic Speeds." NACA TN 1572, May 1948.

Jones, Robert T.: "The Unsteady Lift of a Wing of Finite Aspect Ratio." NACA TR 681, 1940.

Comments on "An Engineering Comparison Using Straight, Swept, and Delta Wings"

BY L. P. GREENE, CHIEF AERODYNAMICIST, NORTH AMERICAN AVIATION, INC.

The following comments, responsive to the Van Every survey on wing shapes, come from a foremost swept wing expert. While specifically representing the position of North American Aviation, Inc., many of the observations by Mr. Greene doubtless will arouse the applause of other companies, including Boeing, who feel that the swept wing assures their survival in the supersonic race.

Invariably when there is a get together of aeronautically minded people at least two questions are raised, Why do you like a swept wing ? or, What do you think about the delta ? Mr. Van Every in his paper, has given evidence of the intention to answer these same questions in the light of his experience, but before I comment on his work it is desirable that you understand the ground rules under which these comments are prepared.

Just as some people like Chevrolets and others like Cadillacs and there are a host of opinions in between, so are there a host of opinions on sweep. One obviously significant point about the Chevrolets and Cadillacs is that they are both cars. This significant point of comparison is not so obvious where sweep is concerned, but, in my opinion, it is nevertheless true. When arguing the virtues of sweep we should consider that swept, unswept or delta, are all wing planforms, all one family and all of a specified sweep.

To me, the straight wing is to the swept wing as a straight line is to a curve. It is a

Sharp sweep and relatively high aspect ratio make the North American F-86 "Sabre" the fastest fighter in the world today (world speed record set up by a F-86D with afterburner on November 19th, 1952: 1126.38 km/h) and also give optimum high altitude characteristics.

singular point by reason of its definition. A straight line can also be said to be a curve of infinite radius. Comparatively a straight wing is a wing of zero sweep of the 25% line, but the leading edge of a normally tapered straight wing is swept back while the trailing edge is swept forward. A delta wing has a singular point in that it has a straight trailing edge and by definition is an isosceles triangle. But it is not, by definition, a tailless airplane nor is it a singular point considering sweep, because, on a delta wing the sweep can vary from nearly zero degrees to nearly 90 degrees if so desired. The main difference between it and the so-called swept wing is that its aspect ratio is directly tied to its sweep by the fact that it must have zero taper and a straight trailing edge. This relationship fixes the conditions such that low sweep has high aspect ratio and high sweep has low aspect ratio.

If the geometric variables considered above are recognized in an analysis of aerodynamic data, we find that the straight, swept, and so called delta planforms fall in one consistent family. There are no singular points in the aerodynamic data and if the designer wishes to have a little more of this in trade for a little less of that he is at liberty to go up and down the aspect ratio, sweep and taper ratio parameters and select his characteristics for the optimum configuration.

With these basic concepts in mind and turning to the paper at hand I have the following specific comments to make. In Mr. Van Every's opening statement he mentions that various configurations can be determined to do various jobs. This I think is the best answer to the original question why do you have sweep? or what do you think about a delta? The designer will pick the configuration that does the best job; the problem is, what is that configuration? For these reasons I prefer not to talk about a delta configuration, because it is limited, but rather to consider this type as a low aspect ratio wing of high sweep.

The author points out three segments of the speed range indicating that the solution might be found in a swept wing in the immediate future, more sweep (he calls it delta) for higher speeds, and possibly zero sweep for very high speeds. The inference is that some place in the speed range, it may result that even the highly swept wing is at disadvantage to the straight wing. There have been indications that this condition exists near the point where the leading edge becomes supersonic; in other words, it is a different point for each degree of sweep being considered. Somewhere near this point the drag level of the swept wing becomes greater than a

The all flying tail of the North American F-86E reduces speed losses in high altitude combat.

straight wing. Although his Figure 8, C_D vs M, doesn't back up this statement I do agree with the contention that from this point on, and from strictly a speed consideration, it becomes advantageous to utilize, once again, zero sweep instead of some finite amount. However, considering controllability, maneuverability, etc. the data shown in Figure 11, static margin versus Mach number, indicates adverse transonic control characteristics for the wing of zero or low sweep.

In the comparison of planforms selected the author stated that "in order to investigate briefly all the possibilities, three definite typical wing planforms have been selected and airplanes designed around them—all for the same basic mission and using consistent assumptions as to aerodynamic characteristics." With this statement I take some exception and it is these assumptions that I wish to comment on in more detail.

First of all I accepted the assumption of constant stalling speed but I couldn't accept the assumption of constant gross weight for such large variations in wing geometry... This should be a serious consideration, at least for the current time span. The author commented that the same fuselage had been assumed for all configurations and for this I also assumed he considered the same fixed equipment and the same combat radius. Even when later on I realized that the author was not making a comparison of wing planforms alone but was comparing conventional and tailless configuration as well, I could not agree that the saving in tail weight could make up for an increase in wing size of a factor of 2. In addition to this it should be realized that the problem of wing twist and manufacturing difficulties is quite real, on his tailless configuration, since elevons are included in the wing planform. When I checked the structural aspect ratio by the definition which I am accustomed to, the value for the delta wing shown was essentially equal to the straight and swept wings chosen. Evidently, then, the author made no consideration of the necessity to increase the effectiveness of the torque box of the wing to account for the large torsional load imposed by elevon control deflection. Therefore, it was evident that Mr. Van Every took the liberty of assuming a lower thickness ratio for the tailless configuration than could actually be justified. It must be assumed that this was done in order to show a greater speed advantage.

Now, I believe that there is a definite structural advantage to utilizing low taper ratio. However, this can be accomplished on what he has called a swept wing without making the necessity of drastically reducing the aspect ratio. Aerodynamically there are certain disadvantages to increasing the rate of taper which show primarily in stall characteristics and surface effectiveness characteristics, as the author hinted later in his discussion.

The second inconsistent assumption that I wish to point out begins with the statement that "an essential difference between the delta wing and the two airplanes having horizontal tail surface is that it is not possible to maintain a high value of static stability margin and center of gravity travel because of the limited trimming power of the longitudinal control surface." Now the statement itself I agree with, but the question is, how do you handle this? The information the author shows in Figure 11 presents a difference in base level of the static stability margin of 10% between the delta configuration and the two conventional airplanes. In other words he is penalizing the conventional configuration by artificially increasing the static margin from 5% in the delta to 15% in the conventional. If 5% is sufficient for the delta then 5% is OK for the conventional too. Although this may not appear off-hand to be very important it is extremely significant in determining the tail size required for satisfactory stability and control of the conventional airplane. Since the big argument on the advantages of tailless configurations is, that by eliminating the tail one can show a considerable improvement in performance, arbitrarily increasing the tail area in the conventional versions is rather a serious handicap to the evaluation and very definitely tends to favor the position of the delta configuration.

The argument is sometimes presented that the reason this is necessary is that the conventional airplane exhibits a reduction in longitudinal stability near the stall which is a result of the high aspect ratio used. Although I agree that at times poor choices have been made, for various reasons, in the combination

of aspect ratio, taper ratio, and sweep, it is my experience that linear static stability characteristics can be obtained, even on wings of considerably higher aspect ratio than those used in this comparison.

Furthermore, why is it that we use high aspect ratio with a conventional configuration ? Certainly there is no law against putting a tail on a low aspect wing but the obvious reason is that there are certain advantages to keeping the aspect ratio as high as can be accommodated. Higher aspect ratio means better altitude performance and better maneuverability because the drag increase with lift is less, and the resulting speed loss in a maneuver is considerably reduced. This point, which was not discussed in the author's paper, is a very important consideration of a fighter type airplane.

Korean experience today indicates that a serious consideration of the ability to combat high performance airplanes is the loss in speed suffered during maneuvers. Attempts to reduce this loss have been acclaimed by our fighter pilots to be the most significant improvement accomplished in some years.

On the delta configuration chosen in the comparison it should be pointed out that not only is the aspect ratio low, tending to aggravate this condition, but the high trim drags of the tailless configuration further add to the problem. I suggest that this is a serious disadvantage to a tailless airplane.

In conclusion I would like to say that I agree, in general, with Mr. Van Every's statements on the effects of sweep and aspect ratio on the aerodynamic characteristics. I believe, however, that the dependency of the tailless aircraft upon gimicks, such as pitch and yaw dampers, does not make for a particularly reliable airplane. I would like to reword Mr. Van Every's concluding remarks to say : It can be concluded that although it is impossible to select one planform for a high speed application, the swept configurations offer the best possibility of achieving supersonic speeds with a given power plant. At very high supersonic speeds a thin low aspect ratio straight wing may have some speed advantages, but until the point is reached where an airplane can efficiently cruise at supersonic speeds the transonic handling characteristics and the maneuverability at high lift coefficients are serious considerations tending to maintain swept configurations, of moderate aspect ratio, as the most promising.

The Delta—Shape of the Future

At San Diego, California, Consolidated Vultee Aircraft Corp. has produced one of the world's first "true" delta wing airplanes—the XF-92A, which made its first flight (as Convair Model 7002) at Muroc (now Edwards) Air Force Base on September 18, 1948. Convair testing of this shape might have remained on an experimental basis indefinitely had not the British instituted an aggressive, heavily publicised delta program of their own. As a result, Convair now has a military production order for a tactical delta closely similar to the experimental prototype. And also, as a result, a considerable amount of Convair's engineering data on the delta shape has become classified. However, the following Convair discussion of the delta, prepared by the research and development section of the engineering department of Convair's San Diego Division, contains a precise, if necessarily generalized, display of the merits of the delta configuration.

THE EDITORS

Aircraft designers the world over are eyeing the triangle-shaped delta wing configuration as the solution to problems posed by supersonic flight in piloted planes.

Published reports from behind the Iron Curtain and from Allied capitals indicate that the delta is being adopted for many future airpower programs. England, Sweden and Soviet Russia, among others, are following America's lead in developing deltas for transonic and supersonic missions.

Consolidated Vultee Aircraft Corporation (Convair) of San Diego, California, placed the United States out in front of world competition shortly after the war by designing, developing, building and then flight-proving the first powered delta wing airplane . . . the XF-92A research interceptor.

The U.S. Air Force has moved to protect this lead by awarding Convair a production order to build supersonic F-102 delta wing interceptors, equipped with "significant improvements in electronics and armament." The F-102 mission will be to spearhead this nation's defense against high speed atomic attack from the air.[1]

Exhaustive wind tunnel studies, supplemented by actual flight demonstrations by the XF-92A during its four years of testing, provide ample evidence that the delta configuration is superior to straight-wing and swept-wing aircraft for high speed operations. The principal advantages may be summarized as follows :

Front view of the Convair XF-92A delta-wing experimental aircraft, forerunner of the F-102A interceptor fighter now in quantity production. Wool threads are stuck on the right wing half and photographed by a cine-camera to show flow behaviour in critical flying attitudes.

[1] At the request of the U.S. Navy Convair has also developed the XF2Y-1 delta-wing flying boat fighter, which is fitted with "hydro-skis" for high-speed taxying or the water. It is to begin flight testing shortly.

Wing Shapes

1. Deltas have less aerodynamic drag at transonic and supersonic speeds. The net effect is that they fly faster with equal power.

2. Deltas are more stable and have better maneuverability than conventional designs — important factors for interception.

3. The delta as designed by Convair experiences no aerodynamic disturbances in the transition from subsonic to supersonic flight—no buffeting, no reversal of controls or the like.

4. Convair's delta design, utilizing a sweepback of 60 degrees at wing leading edges, is basically simpler than other types because the conventional tail section is eliminated. This can mean manufacturing economy in terms of money, materials and production time.

5. Larger wing areas of delta aircraft provide increased lift, and also more space for fuel.

These demonstrated advantages make it easy to understand why the delta is shaping the airpower plans of many nations, including our potential foes.

Apart from Convair's success with the XF-92A, much of the foreign interest and activity in delta wing aircraft can be traced to German experiments during World War II.

The leading figure in the wartime program, Dr. Alexander M. Lippisch, once was a project engineer for the Messerschmitt combine in Germany, and later operated an engineering and development institute in Vienna. Since war's end he has been in the United States, working on special projects for the American Armed Forces.

Long before the war, however, the National Advisory Committee for Aeronautics (NACA) in this country had studied low aspect ratio wings similar to the delta.

So stood the case for the delta in 1945, when Consolidated Vultee received an Air Force assignment to develop a very high performance interceptor, capable of higher altitudes and greater speeds than any previous piloted aircraft.

The problem was turned over to the engineering department at Convair's Downey (Calif.) Division and became the principal concern of three men—Assistant Chief Engineer Frank W. Davis, Chief Design Engineer Adolph Burstein and Chief of Aerodynamics Ralph H. Shick.

They soon determined that a brand new configuration would be necessary to meet the performance requirements of the proposed interceptor. They decided on the delta only after considering all possible shapes, and after minute examination of the NACA's design studies. Captured reports of the Lippisch program in Germany also became available early in the Convair program, and members of the design team arranged for conferences with Lippisch himself to obtain more details on his findings.

The fathers of Convair's delta-wing project and their "baby." Left to right : Thomas M. Hemphill ; Ralph H. Shick ; Frank W. Davis ; Adolph Burstein.

Convinced they were on the right track, the Convair engineers decided to build a wind tunnel model to prove out the theoretical superiority of the delta. This they did for an outlay of little more than $150, with a result so immediately impressive that the Air Force authorized the delta wing for the F-92 project.

Thereafter Convair built models which eventually were subjected to an unprecedented wind tunnel program aggregating more than 5000 test hours. The tests were convincing enough to warrant a go-ahead for construction of a full-size airplane. Thomas M. Hemphill of Convair's San Diego Division was assigned as project engineer for construction and testing of the world's first delta airplane.

There was no precedent to follow, because no flying model with the triangular shape had been built up to that time. Lippisch constructed several wind tunnel models and a delta glider, but the glider had not been completed or flown. Furthermore, in the German models the wings were too thick for ultra high speed performance.

So the Model 7002 project, as it was then called, was a pioneering venture and, like most pioneers before them, the developers and builders had a limited budget of time and money at their disposal. They helped solve the problem by utilizing some parts of five other airplanes in constructing the delta.

The plane was completed in November, 1947, at Convair's San Diego Division and late that month began undergoing full-scale wind tunnel testing in the NACA's Ames Laboratory at Moffett Field, California. Here again the results were exceptional. The engine-less plane was returned to San Diego for installation of an Allison J-33 turbojet powerplant and then shipped to Edwards Air Force Base in California's Mojave Desert for the all-important flight program.

Starting in May, 1948, high speed taxi runs were made over the seven-mile-long dry lake bed at the desert test station before the Model 7002 was pronounced ready for its maiden flight. That historic, but uneventful, feat was accomplished shortly after dawn on September 18, with Convair Pilot E. D. (Sam) Shannon at the controls.

Since then the pioneer delta has made more than 100 flights in a series of evaluation programs, and numerous Air Force pilots have been "checked out" in the plane. They learned that the delta, like other configurations of low aspect ratio, has a nose-high angle for landing and take-off, yet lands at comparatively low speeds.

Among the famous military airmen who flew the XF-92A were Major Charles E. (Chuck) Yeager and then Major Frank K. (Pete) Everest, who probed the so-called sonic barrier in the dart-shaped research plane. Yeager has told aeronautics groups that the delta "can out-turn practically any airplane at any altitude," and is virtually stall-proof.

Looking back on four years of flight-proving the world's first delta wing airplane, Convair's engineering staff believes its original selection of the triangle configuration has been amply justified. This conclusion, moreover, is backed up by investigations carried out by NACA, the British, and others.

Within the limits of security classification, Convair engineers offer a factual and, it can be said, self-evident design report on the merits of the delta wing. It compares the critical performance characteristics of basic wing designs . . . straight, swept and delta . . . with supporting illustrations.

They point out that the advent of high transonic and supersonic flight presented a number of problems to aircraft designers, the main

ones being (a) sharp drag rise as the speed of sound is approached ; (b) abrupt changes in stability ; (c) loss of control, and (d) severe buffeting in the transonic range.

There are three factors in wing design which tend to reduce the drag rise in the vicinity of sound. First is sweepback, second is low aspect ratio and third is low thickness of wing in per cent of chord.

Delta wings possess all three characteristics, the Convair engineers report. Convair's design has leading edge sweepback of 60 degrees, a very low aspect ratio and, because the configuration is structurally highly efficient, wing thickness ratio also is quite low. Of these factors, the thin wing probably is the most important item in holding down the drag rise.

Figure 1 of the accompanying illustrations shows the general trend of wing weight versus thickness of straight, swept and delta wing airplanes of the same gross weight. From this qualitative picture it can be seen that, for the same wing weight, one can build a much thinner delta wing than a swept type. Since drag rise is known to be roughly proportional to the square of the maximum per cent thickness, this advantage of the delta wing is obvious to aircraft engineers.

The engineers explained that the size of the wing must depend upon many performance requirements, such as takeoff and landing, high altitude operation and so on. The usable maximum lift of a delta wing is generally less than that of other wings, they added, but its lower unit weight and minium drag permit the use of larger delta wings than other types without sacrifice of performance or adding to the airplane's gross weight. Furthermore, there is an incidental dividend . . . greater internal volume is available in the delta wing, which means that the fuselage can be proportionately smaller.

On the subject of stability and control at high speeds, Convair's engineers point to experience with World War II fighter planes and postwar conventional types. Wartime fighters experienced severe "tucking under" or "nosing up" tendencies in dives which were, by present standards, made at relatively low Mach numbers.

Later aircraft experienced unexpected wing drop and other sudden stability changes when approaching high speeds. Aerodynamicists have learned that the same factors of sweep, low aspect ratio and relative thinness of wing which minimize drag rise also tend to eliminate stability troubles in the critical speed ranges.

Also encountered in tests of early transonic airplanes was loss of control effectiveness, and even reversal of effectiveness, at high speed. Solution of this problem, as dictated by research, is to utilize low per cent thickness, sweepback and relatively large control flap chord in relation to the local wing chord. Figure 2, showing the planform of the XF-92A with "elevons" cross-hatched, illustrates the point.

An added feature of the delta wing with its low aspect ratio and high taper is the great increase in wing rigidity. This reduces the loss of control effectiveness due to aeroelastic deformation. For example, if the aileron is deflected, the loads on it cause twisting of the wing in the opposite direction. This could, in some cases, offset the loads that are on the aileron, causing the wing to roll in the wrong direction.

The prototype of the Convair XF-92A took off on its first flight from Muroc (now Edwards) Air Force Base, California, on the early morning of September 18th, 1948.

Swept-wing designs exhibit tip-stall at high lift coefficients, and many gadgets such as "fences," leading edge slats and other devices have been used in attempts to correct this defect. The 60-degree delta wing employed by Convair does not exhibit any tendency to an abrupt loss in lift, or to wing drop.

In regard to aerodynamic disturbances, it is widely known that conventional airplanes have encountered severe buffeting when approaching transonic speeds. In some cases the buffeting might have reached destructive proportions if the airplane were flown at high speed at low altitudes.

Generally speaking, buffeting is the result of uneven air flow, which shakes the wing and horizontal tail. The tail appears to sustain the most severe loads. Here again, experience and research strongly indicate that low per cent of wing thickness and sweepback are two important design features which tend to alleviate the phenomenon. In the delta wing design, elimination of the horizontal tail ensures freedom from objectionable buffeting.

At this point it is logical to see whether any penalties, in the way of design complexity, must be paid for the delta advantages. Figure 3 shows two fighter-type airplanes of about the same size superimposed on each other, one a delta and the other a conventional swept-wing craft. Notice the great reduction in the number of control surfaces on the delta. You can see for yourself that this, coupled with the absence of the conventional horizontal tail, results in a much simpler airplane.

It can be freely acknowledged, of course, that the delta wing is not ideal for *every* aircraft requirement. But the vast store of knowledge and experience accumulated since 1945, including wind tunnel tests at all speeds, rocket-propelled models and full-scale flight tests with the XF-92A, back up Convair's contention that the delta is the best solution for human flight in the vicinity of the speed of sound—and beyond.

Fig. 1: Wing weight versus thickness.

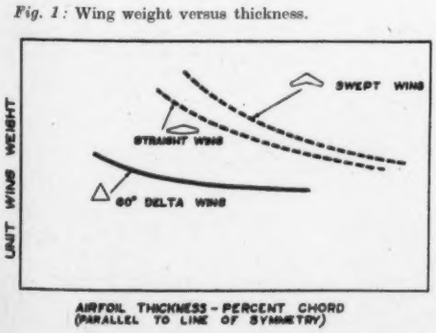


Fig. 2: Planform of the XF-92A, with elevons cross-hatched.

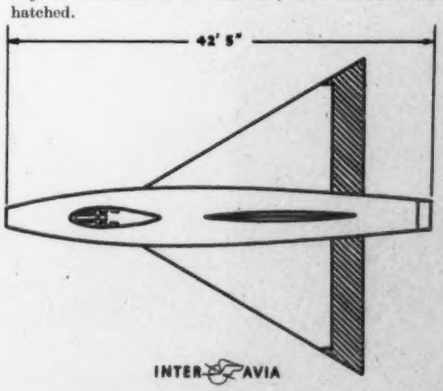
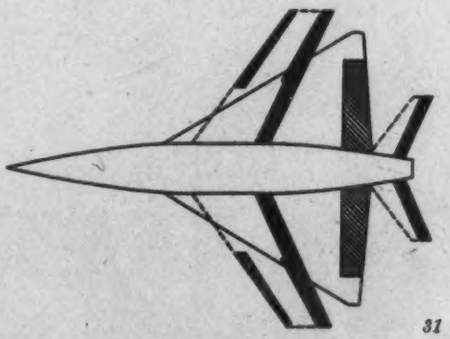


Fig. 3: Comparison of a delta and a swept-wing aircraft of the same size.



Boeing Builds Swept-Wing Bombers

Flight Characteristics of the Boeing B-47 Stratojet

BY ROBERT M. ROBBINS AND WILLIAM H. COOK

As much of Boeing's engineering data in support of the swept wing applies directly to the company's B-47 and B-52 jet bombers, it falls under military security classification and cannot be published at this time. However, discussions with Boeing's key engineering personnel in Seattle have indicated attributes of the swept wing shape which doubtless stem from the classified material. Accompanying excerpts from an SAE report by Robert M. Robbins, B-47 Assistant Project Engineer, and William H. Cook, Aerodynamic Design Engineer, on the flight characteristics of the Boeing B-47 "Stratojet" bomber will serve to imply the engineering data behind the findings of the authors, and also will qualify further the Boeing confidence in this particular wing shape.

The background of Boeing's swept wing program is interesting. George S. Schairer, Boeing Chief of Technical Staff, was largely responsible for pushing the swept wing philosophy for bomber design after viewing results of early German wind tunnel research on the basic subject. He was a member of one of the first U.S. engineering teams to visit German research facilities in 1945, and was touring Volkenrode, Germany's "NACA," on VE-Day. Schairer qualifies his early adoption of a 35-deg. angle of sweep as "the most practical proposition at the time," but adds, "We are not married to the 35-deg. sweep philosophy, however." He concedes that Boeing's engineering department stands ready to utilize either the delta or straight wing "IF it will assist us in fulfilling a desired requirement."

While Boeing officials remain close-mouthed concerning the wing shape employed in a supersonic bomber study and the company's prototype jet transport, there is some reason to believe that neither of these countenance abandonment of the swept wing. One Boeing official inferred as much when, commenting upon the "jet transport race," he said: "It certainly is one of the most intensely competitive situations we have seen in years, and it may become even more so. With our unparalleled experience with heavy, high-speed jets, we believe we are in a good position in the jet transport field. And, it goes without saying, we propose to make the most of it."

Mr. Schairer, too, suggests Boeing's continuing support of the swept wing in reviewing numerous advantages of this shape which have come to light in flying the B-47 and B-52:

Aerodynamic and structural problems inherent in large, swept wings, for instance, have not been insurmountable. The very fact that the wing is flexible gives us a much more stable bombing platform. The wing very effectively 'takes the bumps' while the body rides along very smoothly. The advantages of this in a civil transport are obvious.

"The 'unloading' characteristic of the swept wing, which tends to minimize gust loads, is again a dividend. The placing of our jet engine pods along the span of the wing enables them to act, in effect, like counterweights, and do much both to allow a lighter structure as well as a structure which is not prone to flutter problems." THE EDITORS

Flight testing of the Boeing B-47 Stratojet has been a very interesting program because of many new handling characteristics, and also because the swept wing jet has taken us to new horizons in bomber performance. In order better to understand the flight characteristics, many of which are inherent in the configuration, we will discuss briefly the background of this new United States Air Force jet bomber.

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The principal purpose of the experimental development was to prove that high overall performance could be obtained in jet bombers, and that the flight characteristics would be such that the airplane could be considered entirely satisfactory for tactical use. By so doing, the likelihood of early acceptance as a production airplane would be enhanced.

The latest version (series B) of the Boeing B-47 "Stratojet" six-jet bomber has been fitted with more powerful General Electric J-47-GE-23 engines and wing-tip fuel tanks: span 116 ft., length 108 ft., gross weight 185,000 lbs., max. bomb load 20,000 lbs., max. speed approx. 620 m.p.h., range 2600+ miles.

Early design studies showed that the performance goals of meeting a range requirement with the maximum speed could be obtained best with a swept wing design, using six of the currently available engines and a high aspect ratio wing. The six engines in nacelles are arranged to give minimum influence on wing limiting speed, low fire vulnerability and to provide easy access for maintenance. The engine arrangement was also designed to have favorable effects on stalling characteristics, flutter speeds, and longitudinal stability.

Due to the unknowns with control surface hinge moments at high Mach numbers, all three controls are operated by *irreversible hydraulic servos* with artificial pilot feel and centering. If there is a failure of the power control, emergency operation is provided through conventional cable controls, assisted by internal aerodynamic balancing.

If done properly this combination gives a pleasing impression since the airplane appears very maneuverable with minimum control effort. Pilots are a bit like automobile owners, wanting maximum effectiveness with minimum effort and attention. A typical pilot comment describing the B-47 is that "she flies and handles like a fighter."

Stalling characteristics were supposedly bad on swept wings. Since no time was available for flying scale models, careful attention was given to wind tunnel tests. These determined the design of airfoil sections and slats, and demonstrated the importance of proper nacelle location. The large dihedral effect of swept wings at low speeds also was shown to be a possible source of difficulty, particularly on cross wind landings. The satisfactory solution on the B-47 was the use of a powerful lateral control with flaps down, i.e. by partially retracting the outboard section of the flap as "up" aileron.

Another special design arrangement affecting the flight characteristics is the tandem, or bicycle landing gear. This was arrived at by numerous studies of internal arrangement. Neither jet nacelles nor the wing are big enough for a main gear such as is required to carry the load of the B-47. Therefore, a gear retracting within the body was necessary.

The cockpit resembles a fighter because of the canopy and tandem

Before the final design of the B-47 "Stratojet" (model in foreground) was decided upon, comparative measurements were made in Boeing's wind tunnel with models of other shapes. The second (with four jet engines in the fuselage) and third models have the characteristic form of the Boeing B-29 "Superfortress."

seating arrangement. The pilot has exceptional visibility over the nose and on both sides, as well as above and aft. Flight controls are conventional, the throttles are clustered together on the right stand for easy grip by one hand. Each jet engine is operated by only one lever affecting power, as against four controls on the usual reciprocating engine-propeller combination. The co-pilot has a similar arrangement and in addition has control of the electrical system, emergency landing gear and flap, and other equipment normally not requiring operation. The co-pilot's seat is elevated over the pilot to improve vision. Landings are possible from behind, which aids in training.

Taxiing

The B-47 is very easy to taxi. After it is started rolling by a short period at moderate power, idling thrust is sufficient for taxiing. Turning at low speeds can be made about very short radius and is accompanied by a noticeable "heeling over" sensation. Steering is accomplished entirely by a steerable nose wheel controlled by the rudder pedals. This arrangement was found to be the most natural and convenient means, since differential braking is obviously not available. Differential power on the outboards is not used. At moderate taxiing speeds the pilot can roll the airplane slightly with the ailerons, compressing the soft outrigger oleo struts.

Take-off

The take-off is accomplished in a normal manner. Pre-run up of engines is not necessary, as a power check can be made during the first part of the roll. Due to the large fore and aft spread of the tandem gears, the pilot has virtually no control over the attitude on the ground, which was selected for optimum take-off speed, considering take-off distance and performance after take-off under emergency conditions.

Take-offs are made with full flap. At the unstick point the airplane flies off the ground with the elevator near neutral, very similar to the B-17 or other tail wheel airplanes having a low ground attitude.

One important point on take-off is the comparatively long ground runs, particularly on hot days. It is believed that developments in engine augmentation and improved rocket assist will aid considerably the critical hot day problem. For the present, solid ATO provides extra take-off thrust. Directional control with unsymmetrical power is not critical, in spite of the apparent large moment arm of the outboard engine.

During cross wind take-offs a large amount of aileron control is required to keep the B-47 laterally level. In addition, the drift of the airplane at speeds appreciably below take-off speed is very noticeable because of the difference between the airplane's heading and track down the runway.

In general, the feel of the B-47 on take-off is very similar to that of a flying boat.

Climb out

After take-off the gear is retracted, followed by the flaps. The speed of flap operation is such as to match the accelerating characteristics of the airplane. During flap retraction a retrimming device prevents any change in trim so that no longitudinal trimming is required until best climbing speed is reached. Particularly appreciated on a refused landing is the negligible effect of power changes on trim. One new characteristic of jet airplanes is the very high speed for best rate of climb, as well as the high maximum rate of climb.

Where terrain permits, this results in a low angle climb during acceleration, followed by a steeper and rapid climb to the high altitudes desired for cruising. Where required for clearance reasons, steeper angles can be obtained at the expense of efficiency by holding the speed down since engine cooling is not a problem.

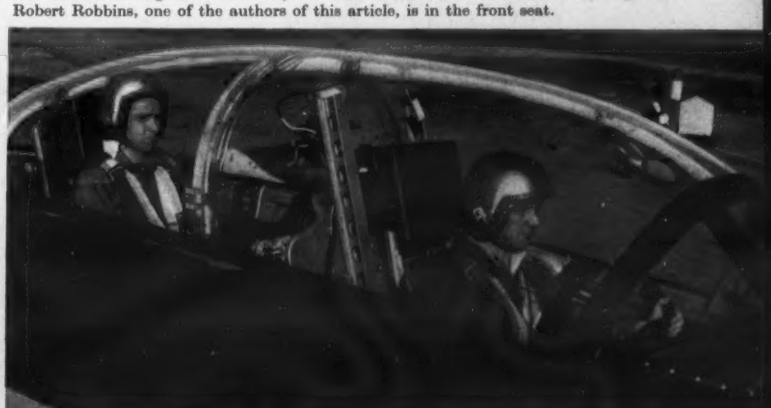
Rough air stability

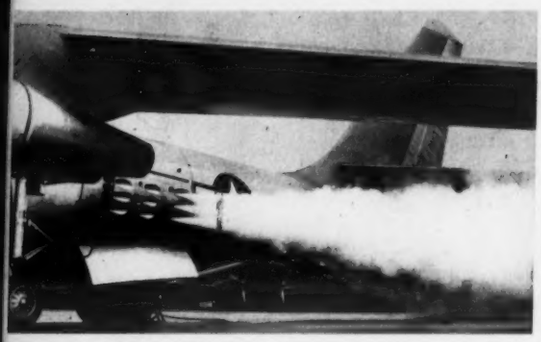
The characteristics of an airplane in rough air tend in the long run to have more eventual influence on a pilot's opinion than some of the more spectacular phases of flight. Longitudinally the B-47 is very much less disturbed by turbulence than non-swept wing bombers. One of the characteristics of swept wings is the load-relieving tendency of the wing tips. Furthermore, the unusual flexibility of the B-47 wing helps to "take the bumps." In rough air this wing flexibility is quite apparent. The pilots can see the wing tips and outboard nacelles "riding the bumps" while the cockpit is riding smoothly. This characteristic provides a more stable bombing platform.—Damping of the longitudinal motion following a gust is high, with no visible "short period" oscillations.

Laterally, the airplane is much more disturbed by gusts. Early in the flight tests it was found that under some conditions a "Dutch

Wing shape and positioning of slats (later omitted) and engine nacelles were checked in the wind tunnel. Wool tufts are used to indicate flow behaviour.

The tandem arrangement of the ejector seats in the B-47 recalls that of a fighter. Robert Robbins, one of the authors of this article, is in the front seat.





Eighteen Aerojet solid fuel rockets give up to 9 tons of additional thrust to assist the B-47's take-off.

Smooth landings with the bicycle undercarriage necessitate the observance of close tolerances for speed of approach and flying attitude. As a rule the pilot opens a brake parachute on touching down.

Roll" oscillation would die out slower than desired. Whereas, many conventional airplanes have a yawing oscillation following a side gust, the higher dihedral effect of swept wings causes a coupled rolling, which is the objectionable component to pilots. By applying a small corrective motion to the rudder, using some of the autopilot developments in what is called a "yaw damper," these oscillations can be damped as well or better than in conventional straight winged airplanes.

Stalls

Straight wing airplanes often have an abrupt stall, due to the whole wing "letting go" at once. This undesirable condition rarely exists on a swept wing where some sections hold on for a long time. Stall warning on swept wings is usually more pronounced, with a wider speed band. Because of this stall warning there is little excuse for inadvertent extreme stalls on the B-47.

Most large airplanes which do not limit the amount of elevator control have rolling tendencies in the extreme stall. This is also true on the B-47. However, powerful lateral control is available, and in the stall tests the pilot was able to hold the wings level by rapid control movements, the wing getting down to 30 degrees in only a very few instances. During an extreme stall there is so much buffeting in the B-47 that it is hard to conceive of this small amount of roll having any practical significance. Pitching in a full stall is mild. No loss in altitude occurs on approaches to stall warning when followed by proper recovery. A large loss in altitude does, of course, occur on complete stalls, as is true on all heavily-loaded airplanes.

Because of the good stalling characteristics that exist without wing slats, they are being eliminated on production airplanes. The removal of the slats, which were provided for insurance against possible poor stalling characteristics, will save approximately 600 pounds and simplify maintenance and manufacture of the B-47. The slats are typical of one of the features incorporated so that positive control of the airplane's characteristics would be assured—the "brute force approach." This one feature proved unnecessary.

Rapid descents from altitude are made with the landing gear down. The flaps are put full down in the landing pattern which is slightly wider than for B-29 airplanes. On final approach the pilot must maintain the desired airspeed more carefully than on past airplanes to avoid using excessive amounts of runway and still maintain an adequate margin over the stall. One disadvantage of the tandem gear is that the speed range in which smooth landings can be made is more limited than on other types. It is obvious that with the tandem gear the airplane cannot be landed at a speed much higher than that for simultaneous contact of both gears. Touching the front gear first with an appreciable rate of descent will result in a bounce back up in the air, or will at least prevent enough load being applied to the wheel to permit effective braking. Usually on contact the pilot releases the drag chute. In addition to the parachute an anti-skid device has been developed by Boeing which is also a very worthwhile improvement to the original XB-47 configuration. More consistent stops with far less tire wear are possible under all conditions with the anti-skid device.

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In conclusion it is our opinion that the Boeing B-47 Stratojet will achieve universal acceptance enjoyed by few airplanes. Its ability to do a job coupled with the enthusiastic reception given it by pilots assures it an important place in history.

The Straight Wing—Aerodynamic Step-Child or Supersonic White Hope?

When Lockheed Aircraft Corporation's Hall L. Hibbard announced that his company's future supersonic military craft will fly on straight-thin wings, the straight wing segment of the airframe industry brightened as if it had just received a shot of adrenalin.

However, time alone, plus one or more prototypes, will prove whether the straight-thin shape is to become the Cinderella wing of supersonics or remain a step-child consigned to chores spurned by the glamorous swept and delta winged creations of a speed-hungry era.

Lockheed has not always been true to the straight wing, as this picture of the 35° swept prototype (since abandoned) of a F-90 twin-jet penetration fighter shows.

Asked for an elaboration of his straight wing pronouncement, Mr. Hibbard, who as engineering vice-president of Lockheed is empowered to speak directly on his company's plans and policies, said, "We believe in the thin wing for supersonic military aircraft be-

The latest version (C) of the Lockheed F-94 "Starfire" two-seater all-weather fighter : thin unswept wing ; swept horizontal tailplane ; elephant-ear air intakes ; 24 rocket projectiles in fuselage nose ; no cannon.

cause it is sufficiently superior in the important performance parameters. It is extremely difficult to estimate the degree of superiority of the thin straight wing, but I believe it can be rated 7 to 10 percent better than either the delta or swept wing. Such a comparison stems from an over-all consideration of all the different points of the various wings."

Beyond that, with now and again a brief and not too well defined jab at delta and swept wing proponents in engineering bull sessions of the West Coast industry, Lockheed is silent.

"We cannot, of course, give curves and data showing our position in this matter, because of secrecy regulations," Hibbard insists.

Upon occasion Lockheed will give competitors a quick, flash look at beautifully colored charts which are presumed to indicate straight wing supersonic superiority. At a recent meeting of the Institute of the Aeronautical Sciences in Los Angeles this was done by Philip Colman, Lockheed's chief of aerodynamics. The reaction of swept wing supporters was typified by L. P. Greene, chief aerodynamicist of North American, who quipped : "I haven't quite got this shell game worked out—but I appreciate the indoctrination."

In this behavior there is possibly an indication that Lockheed for company reasons, as well as in observance of the dictates of military security, chooses to keep its competitors guessing while the firm's engineers convert to blueprints the findings which lead Mr. Hibbard to estimate a "7 to 10 percent" superiority of the straight wing over contestant shapes. Lockheed's new supersonic fighter will probably have the designation F-104 and be fitted with an "extremely high power" jet engine for *sustained* supersonic flight.

The admission from within Douglas ranks (the Van Every report, Page 23), that the straight and thin wing shows promise at very high speed ranges would seem to establish that Lockheed is not merely whistling in a dark alley.

It is highly possible that Lockheed, momentarily the sole and vocal leader of the supersonic straight wing faction, will be more expressive when swept and delta wing proponents concede to a set of test factors agreeable to the company's engineering leaders. In fact, Clarence L. Johnson, Lockheed's chief engineer, indicated as much during the IAS meeting addressed by Colman :

The Northrop F-89 "Scorpion" all-weather two-seater twin-jet fighter. Armament : six 20-mm cannon in fuselage nose.

"While there is a lot of confusion in our own ranks, look how we're confusing the generals !

"We haven't the same sets of ground rules. We've got to establish the same set of ground rules, and let's get the ground rules straight."

Both Colman and Johnson indicated that a significant "ground rule" for evaluation of the different wing shapes will be the measure of airports required for safe operation of military supersonic aircraft.

Needled Johnson : "If you have to land like a ton of bricks with a delta wing, lets do it with a straight wing !"

Irving Ashkenas, chief of aerodynamics for Northrop Aircraft, Inc., while not as outspoken as Lockheed officials on the supersonic possibilities of the straight wing, feels that the straight shape will continue as an important wing due to the room it provides for internal stores and its relatively lighter (than swept and delta designs) contruction.

More specific is John K. Northrop himself. Thinking of the higher speed ranges, he says, "It is known that at high Mach numbers, above 2, sweep becomes ineffective." He concedes that at lower Mach readings, the degree of sweep falling within the angle of the Mach wave, swept wing drag at supercritical speeds is less than that of a straight wing of equivalent airfoil thickness measured in direction of flight. In further elaboration of his company's adherance to the straight wing, Mr. Northrop said in a recent issue of Air Force magazine :

"For a given aspect ratio and airfoil section, increasing sweep means increasing the effective length of the wing panel in bending. Therefore, to alleviate the root bending, heavier construction is necessary. Thus, the weight of the aircraft for the same thickness of wing profile is increased. Conversely, if the weight of the airplane is to remain the same, the thickness of the swept wing must be increased, thereby offsetting the reduction of drag gained by the sweep. Consequently the drag characteristics at high speeds are often the same for swept wings and straight wings of the same weight . . . The use of wing sweep is drag reduction at a price. In some cases the price is worth the paying ; in others it is not."

Additional References

Lowry and Scheiter : "Investigation at Low Speed of the Longitudinal Stability Characteristics of a 60 degree Sweptback Tapered Low-Drag Wing." NACA TN 1284, May 1947.

Hopkins : "Lift, Pitching Moment and Span Load Characteristics of Wings at Low Speed as Affected by Variations of Sweep and Aspect Ratio." NACA TN 2284, January 1951.

Fischel and Hagerman : "Effect of Aspect Ratio and Sweepback on the Low Speed Lateral Control Characteristics of Untapered Low Aspect Ratio Wings Equipped with Retractable Ailerons." NACA TN 2347, May 1951.

Purser and Spearman : "Wind Tunnel Tests at Low Speed of Swept and Yawed Wings Having Various Plan-Forms." NACA TN 2445, December 1951.

Japanese youth is looking forward to the revival of the aircraft industry . . .

A Japanese come-back?

"No" says the Eastern Bloc—
"Yes" says the West

" . . . Japan has not regained full independence . . . she must be regarded as an American base, a dependent United States Colony . . . the willing tool of America's imperialist plans . . . jumping-off point for a potential United States offensive against the Far East . . . "

These are the words used by Russia's United Nations delegate Jakob Malik at the meeting of the Security Council on September 17th, 1952, to justify his vetoing Japan's admission to the United Nations.

The Russian veto comes to a certain extent after the event. Admittedly it excludes Japanese delegates from participation in United Nation's deliberations for the time being, but it cannot undo what has been done in the years since the war : the progressive improvement in Japanese-American relations (not least in the field of civil aviation—Japanese study groups have been sent to the United States, American airlines have provided assistance for Japanese air transport, etc.); the conclusion of the Peace Treaty, speeded up by the outbreak of hostilities in Korea, and signed by 48 States in San Francisco on September 8th, 1951—in spite of Russian opposition ; the military pact between the United States and Japan concluded the same day . . . all these facts speak for themselves. Japan is recognized and treated by the West as a sovereign power. In particular, the Peace Treaty gives her the unrestricted right, written into the United Nations Charter, to individual and collective self defence.

John Foster Dulles, the father of the Japanese treaty—into whose hands the fate of American foreign policy will pass on January 20th, 1953—particularly stressed Japan's right to conclude military alliances. In his speech to the peace conference at San Francisco (September 5th, 1951) he rejected a Russian proposal that Japan should have the right to individual but not to collective defence, with the following words :

> "That kind of a peace, in this present kind of a world, would be a fraud. To give a sovereignty which cannot be defended is to give an empty husk."

On the economic level the Treaty incorporates Japan in the world economic system and gives her the right to join the international organizations. For example, the United Nations agreed in November 1952 to Japan's admission to the International Civil Aviation Organization, of which she will thus become the 58th member. This means that Japan Air Lines Co. may join the International Air Transport Association.

The dowry

The West has said "yes," and forms have been preserved. On both the military and the civilian side Japan has been readmitted to the circle of airfaring nations with full rights. In other words, the banns have been called. What is to be the dowry ?

To put it plainly, Japan has to start out rebuilding her aircraft industry with empty hands. Unlike Germany, where there are still vestiges of the pre-war industry to build on, Japan's industry—and not only the aircraft industry—was wiped out lock, stock and barrel. This was largely due, as we shall see, to faulty planning. But many other things are lacking too. For example, practically all of the better pilots, who would have formed a link with pre-war experience, were killed in the War.

One of the most active Japanese aircraft industrialists was the late Rugo Kawanishi, president of Kawanishi Aircraft Co.

Moreover, the development of aviation in Japan up to the outbreak of World War II was far from having reached the same point as in the Western countries. There were no long-range aircraft or long-distance services in the Western sense. The building of heavy bombers and transports, such as were manufactured before and during the war in the United States and, for a time, also in Germany, was never seriously envisaged in Japan.

Japan made few long-range aircraft before the war. One of these was the "Emily" patrol flying boat made by Kawanishi Aircraft Co. Ltd. Engines : Kasei Type 22, of 1850 h.p.

To an even greater extent than Germany, Japan was obliged to concentrate her aircraft industry on pure fighter production during World War II. A squadron of Kawasaki 95s as used by the Japanese Army Air Force in the Sino-Japanese war.

No illusions

So as to get a more or less undistorted view of Japanese potentialities in the aviation domain, certain mistaken ideas, firmly rooted in Western minds, must be eradicated. The Japanese are neither pure "imitators," incapable of creative effort of their own, nor technical "wizards" to whom the most unlikely achievements are child's play. They must not be regarded either as "cool calculators" who never make mistakes, or—except in a few military tests of courage—as a shining example of State discipline and self-denial, which even goes as far as complete negation of all personal will.

The technical and economic development of the Japanese aircraft industry should suffice to show the mistaken nature of all such generalized opinions.

Taken out of its economic context, the list of Japanese licence productions of the pre-war period might indeed suggest that the Japanese are pure "imitators" : *German* Messerschmitt Me 109 and Me 110 fighters ; Heinkel He 111 bombers ; Junkers Ju 87 and Ju 88 dive bombers ; *Italian* Fiat BR 20 bombers ; *British* Short flying boats (which were later developed into Kawanishi models) ; *American* Northrop monoplanes (on which the design of the Mitsubishi "Kamikaze" record-breaking aircraft was based—Tokyo-London, 1937).—Not forgetting the *"free copies"* of American types such as the Douglas DC-2 and DC-3.—And the *engine and propeller* licences from Hispano Suiza, Bristol, Rolls-Royce, BMW, Hamilton Standard. British Vickers machine guns, Swiss Oerlikon cannon, Hispano-Suiza guns . . . There was scarcely a foreign aircraft, engine, weapon that was not imported, tested and copied in Japan.

Yet this does not prove lack of originality or poverty of ideas in Japanese engineers. The reason is simply that Japan did not begin producing aircraft until the industry in the West was fully developed. And this applies not only to the aircraft industry, but to all industry, particularly the heavy industry, without whose powerful backing no aircraft industry can mature. Remember, for example, that in 1907 there were no more than 16 (!) automobiles in the whole of Japan . . . less than the number of taxis in any large European city. This too was not surprising. When Japanese industry was born in the 'eighties and 'nineties—twenty-five years after the more or less forceful opening of the Japanese ports by Commodore Perry's American squadron—the chimneys in Sheffield, Manchester, the Ruhr, Lorraine, Pittsburgh had been smoking for more than half a century. Again it must be remembered that Britain, France, Germany had fully-developed heavy industries, whereas up to the turn of the century Japan was restricted to silk and cotton factories.

Under an agreement signed in October 1951 Northwest Airlines undertook to aid the newly-founded Japan Air Line Co. by leasing it Martin 2-0-2s and Douglas DC-4s and lending pilots and maintenance personnel. The agreement being signed. Centre of picture, left : Aiichiro Fujiyama, Chairman of JAL's board ; right : P. J. King, Vice-President of NWA ; Seijiro Yanagita, President and Managing Director of JAL.

Since the outbreak of the Korean conflict such parts of the Japanese aircraft industry as survived have been systematically contracted to work for the U. S. Air Force. Production of fuel tanks at Kawanishi Aircraft Co.'s Narvo works.

Japan's aircraft industry was not developed until the 1930's, or to be more accurate it did not get into full swing until 1938, when the United States placed an embargo on the sale of arms to Japan, and the Japanese authorities replied by introducing a *law organizing the Japanese aircraft industry on a rational basis.* This law, passed by the Japanese Parliament on March 27th, 1938, led to a thorough sifting, centralisation and subsidizing of suitable firms. Only works with a minimum output of 100 aircraft, 300 engines or 300 propellers a year were permitted to produce. The selected firms received substantial Government aid in the form of exemption from income and purchase tax, exemption from import duties on machinery and raw materials, subsidies for the development of prototypes, loans, authorization to requisition land for the expansion of factories, etc.

What this brand-new industry then turned out within the next few years, or even months, was quite spectacular.

Service on board JAL's aircraft follows Japanese tradition.

The following table comparing wartime production of aircraft by four big powers, USA, Great Britain, Germany and Japan is eloquent enough :

Wartime aircraft production

	1941	*1942*	*1943*	*1944*	*(Total 4 years)*
Japan	5,088	8,861	16,693	28,180	58,822
Germany	11,766	15,556	25,527	39,807	92,656
Great Britain	20,100	23,600	26,200	26,500	96,400
USA	19,433	49,445	92,196	100,752	261,826

State discipline and aircraft industry

There can be absolutely no doubt of the military qualities of the Japanese, the exceptional courage of the Japanese soldier and pilot, or his instinct for military obedience. These are well known. What is less known is the complete lack of foresight, self-discipline, corporate planning and disinterestedness to be found among the top civilian and military personalities during the decisive years of development in the Japanese aircraft industry, the period just before and during the second World War. The confusion and rivalry in equipment planning by Army and Navy Air Forces, the selfishness and petty quarrels inside the aircraft industry, the short-sightedness in planning the location of individual factories, are almost unbelievable.

One of the reasons for these fatal intrigues doubtless lies in the well-known fact that the whole of pre-war Japanese industry was concentrated in the hands of very few families. The list of the "Zaibatsu" (the finance and commerce dynasties) contains at the most some 12 to 15 names, among which those of Mitsui, Mitsubishi and Kawasaki were particularly important in aviation.

This concentration of ownership is doubtless also responsible for the centralization of the whole Japanese industry in a narrowly circumscribed area on the main island of Honshu, where it was an easy prey to American bombers. No less than 72% of the Japanese aircraft production came from factories within a 30-mile radius of Tokyo, Nagoya and Osaka, Japan's largest cities.—The neutralization of the decentralized German industry during World War II took 90,000 tons of bombs and two-and-a-half years. In Japan only 16,000 tons of bombs and thirteen months were needed to achieve a much more thorough result . . . one of the reasons why the Japanese aircraft industry today has to start from scratch again.

An error of judgment undoubtedly, yet far less serious than the bitter wrangling between Army and Navy Air Forces, and between these two services and the industry ; wrangling which, without actually costing Japan a final victory she could not in any case have achieved, did decisively hamper the development of the Japanese aircraft industry . . . and cost many a Japanese pilot his life. Practical examples of this are :

Ginjiro Fujihara, industrial adviser to the Japanese Government and later Minister of Supply, described this situation when interrogated by the American Strategic Bombing Survey after the war as follows : Japan had produced 8,000 to 10,000 aircraft a year, but could have built 50,000 . . .

"We were certainly not short of production plant and machinery, but when the Army ordered a new aircraft factory, the Navy, not to be out-done, had to have one too."

One day the Government discovered that in these new factories that had sprung up like mushrooms only 55% of the aluminium allocated was being used for its legitimate purpose, and the remaining 45% was being wasted on useless projects . . . or going into the black market.

A Japanese industrialist, Yasujiro Okana, technical director of Mitsubishi Heavy Industries, gave evidence that :

"When foreign aircraft or designs came into our hands, both Army and Navy inisted on being the first to evaluate them, with the result that the plans got to the industry only after long delay. Moreover Army and Navy, in their fear of competition, each took only one manufacturer into their confidence, and all documents were treated as top secret. Thus the grotesque situation arose several times in which two different firms were ordered to produce the same foreign aircraft—in the strictest secrecy—one by the Army, the other by the Navy."

The sun will rise again . . .

These painful memories are not revived here for the pleasure of indulging in criticism after the event, or to detract from the energy of the Japanese citizen or the efficiency of the aircraft industry. Our admittedly superficial sketch, in which much that is positive has had to be left out of account, is designed merely to show how much, or rather how little, is left on which a new Japanese aircraft industry can be founded.

Finally the peace treaty deprived Japan of highly valuable overseas population and industrial areas (Formosa with 350,000 Japanese settlers ; Korea : 650,000 ; South Sakhalin : 350,000 ; Kuriles : 11,000 . . . and above all Manchuria, where there was a vigorous off-shoot of the Japanese aircraft industry). After the end of the war, Japan was ruthlessly disarmed, and the last remaining aircraft production plants and equipment went on to the scrap heap.

What is the position today, the beginning of 1953 ? Up to April 1952 the Japanese aircraft industry was forbidden to produce any aircraft.

A JAL Douglas DC-4 at Tokyo's Haneda International Airport.

Japanese Prime Minister Shigeru Yoshida inspecting JAL's first DC-4.

Such of the former firms as still existed had to convert to producing small cars, buses, delivery trucks, etc.

But as early as the middle of 1951 the first friendly feelers were being put out by American and European firms. What the representatives of Douglas, Bell, de Havilland, Bristol, etc. found when they visited Japan's five former leading concerns must have been disappointing.

However time—and America—presses.

Just a few weeks ago Washington asked Japan to increase her National Security Corps (the nucleus of her future armed forces) from 110,000 to 320,000, or at the very least to 180,000 men. The Yoshida Government, faced by serious economic difficulties, replied that this was not possible, but agreed to modernize and mechanize the Japanese forces. Early in November it was reported from Tokyo that the Security Corps was expected to place orders in the near future for fighters, or at any rate for trainers. The firms chosen would probably be given financial assistance.

The only question is whether and to what extent the industry is ready for even modest quantity production.

What can be done in the way of organization "from above" is doubtless being done. Early in November 1952 the Japanese Ministry of Commerce and Industry drew up a three-year plan to help the aircraft industry get on its feet. It covers three main points : 1) subsidies for aircraft works (including those making trainers and helicopters), which as a "new" branch of industry enjoy the same privileges as the export industries ; 2) establishment of a development plan for fighters and bombers ; 3) a centralized system of distributing the American Far East Air Force's orders for aircraft parts.

The last point acquires particular importance in present circumstances. Since the outbreak of the Korean war the USA Air Force has gradually contracted with the former big manufacturers—Mitsubishi, Nakajima, Kawanishi, Kawasaki, Showa, etc.—for the production of such parts as fuel tanks and cowlings. This has given these firms an opportunity of seeing what modern aircraft are like. Now they are once more to rise so to speak from the "retail" to the "wholesale" business level. If all goes well, two or three works will be able to start on extensive maintenance and repair work early in 1953.

To guide the revival of the industry into rational channels from the start, the Cabinet decided on October 26th to form an Aircraft Production Advisory Council, of which industrialists, transport experts, raw materials suppliers, designers, representatives of official agencies, finance experts, etc. are members. In addition the 1953-54 estimates are to include credits for the creation of an aeronautical research institute and provide funds to encourage private research work on the part of industry.

A modest beginning, undoubtedly. But once the Japanese get started . . .

Japan Air Lines Co.

Compared with the aircraft industry, Japanese air transport is showing greater signs of life. Admittedly there is nothing here either in the nature of a boom. On November 1st, 1952 there were exactly 26 aircraft registered in the whole of Japan ; these included 19 single-engined, 2 twin-engined, 3 four-engined aircraft and two helicopters. Only five of this total were in use by air transport, the rest belonging to all types of businesses, including eleven newspaper publishers . . .

Be that as it may, Japanese personnel are already operating Japanese domestic services again, air transport agreements are being concluded with foreign countries and serious plans being made for overseas operations. All this in spite of the fact that the pre-war organization had been destroyed probably even more thoroughly than in the case of the aircraft industry. All that remains of Japan Airways Co., Manchuria Aviation Co. and the swarm of smaller companies is the shadow of a historical memory.

The name Japan Air Lines Co. has been used as heading to this paragraph, since this is at present the only Japanese company authorized to engage in scheduled air transport, and—what is more—the only undertaking with a solid economic backing. When JAL was founded on August 1st, 1951, one hundred and thirty representative personalities from Japan's economic world stood sponsor.

Until the peace treaty was signed the Japanese had to be content with running air freight forwarding agencies, while actual air services were operated by American companies. It is from this period that JAL's relationship with Northwest Airlines dates. The latter gave much advice and practical assistance to the young Japanese concern in its early days, and—most important of all—lent it three Martin 2-0-2s and two Douglas DC-4s.

When this agreement with Northwest expired on October 25th, 1952, JAL had to look round for aircraft of its own. It bought four Douglas DC-4s, and a DC-6A, and ordered a DC-6B for its projected Pacific services. And in 1955 it expects to get its first de Havilland "Comet" jet airliner.

In addition to the domestic routes already operated, services are planned to Korea, Formosa, North and South America, Europe and Java. But all this will be far in the future. Our object here is merely to give an unvarnished picture of Japanese aviation as it is today . . . As a lady of the Japanese court wrote in der diary a thousand years ago : Nobody is more to be pitied than a man who has the reputation of being perfect.

Connie Courts

Air of structural "solidity" is created in the eight-seat lounge—at the entrance to the 32-seat main cabin—by heavy tweed and leather chair coverings, oak panelled wall, heavy carpeting. Note the flowering "planter" installed behind leather seats. Elaborate mural maps will help relieve monotony of a long trip.

Meal service aloft will be in luxurious keeping with the furnishings of the "Super Constellation's" new cabin.

By the time this appears in print, Lockheed Aircraft Corp. will have unleashed a strident fanfare of publicity on the considerable investment it has made to create a new interior for the turbo-compound-powered version of the "Super Constellation" transport.

From the vantage point of an elaborate mockup of the new interior it is apparent that the remodeled cabin, created by Henry Dreyfuss, leading U.S. industrial designer, will be a delight both to those who ride the new "Connies" as fare-paying passengers and to Lockheed's busy sales staff.

Mr. Dreyfuss has poured into the 76-ft. long "tunnel" of the air-plane's passenger area a bagful of illusion and solid industrial artistry which doubtless will influence strongly the design trend of the American industry in its move toward the long, thin cabins of future jet transports carrying 100 passengers or more.

Basically, the new "Constellation" interior breaks up the cabin into three well-separated sections (forward cabin, main cabin and small lounge, aft cabin), thus relieving—except in some of the high-density versions—the feeling that a disconcertingly large number of persons is crowded together in one airplane.

From that concept, the designer has proceeded to extend the illusion of roominess and structural solidity in a variety of ways.

Cabin trim, for instance, flows unbroken through each compartment. The coat-and-pillow racks above the seats extend seamlessly the length of each section, and similarly the carpeting is seamless and wall-to-wall.

The previous domed ceiling, giving a feeling of crowding-toward-the-aisle, has been eliminated; it has been replaced by a flat-surfaced ceiling that suggests, as well as actually gives, ample headroom from one side of the cabin to the other—and interestingly creates the illusion of unusual cabin width.

the Customer

Looking aft from the forward compartment to the main and rear compartments the effect of a "flying tunnel" is abolished by compartmentation of the new interior of the "Super Constellation." Separation bulkheads, of wood panels, give an air of massive strength. The flat ceiling relieves the "railroad coach" effect of former domed ceilings which followed the fuselage contour.

From the rear cabin one has this view forward past the striped-carpet entrance (the stripes are a Dreyfuss design trick to give an illusion of depth as the passenger boards) into the lounge and main cabin beyond, and on to the distant forward cabin.

Bulkheads separating the three compartments are mainly oak, and of unbroken surfacing. They thump "solid" under one's inquiring knuckles, and create the forgiveable illusion that they are massive inserts to add to the structural strength of the cabin, although actually they are a thin veneer on either side of a foam plastic core.

The feeling of "solidity" is borne out, further, by use of extremely heavy fabrics on the majority of seats, and by some seats done in heavy leather. A choice of "earthy" low-toned colours also seems to add to the passenger's sense of a strong, solid structure. Colour decoration ranges, in the mockup (representative of the first installation, which will go into planes ordered by KLM), from beige and blue in forward and aft lavatories to medium brown, tan and dark brown in the lounge, which is just forward of the cabin entrance and leading into the main cabin. Grey and blue dominate in the colouring of cabin seats.

An obviously attractive feature of the new cabin will be its large, rectangular, blue-tinted "view windows" providing 85 percent more visibility than is offered by the round ones common to previous versions of this type.

Mechanical ingenuity, too, has entered into the "new cabin" designing. Seats are mounted upon floor-flush tracks for ready translation of the interior into high or low density accommodations and for complete removal from the forward cabin to turn this area into a cargo compartment. Curtains bordering the windows slide at fingertip touch. The galley is unusually positioned, directly facing the main cabin entrance, for easy and quick servicing, and when not in use is concealed by a windowshade curtain which bears, for decoration, the insignia of the airline.

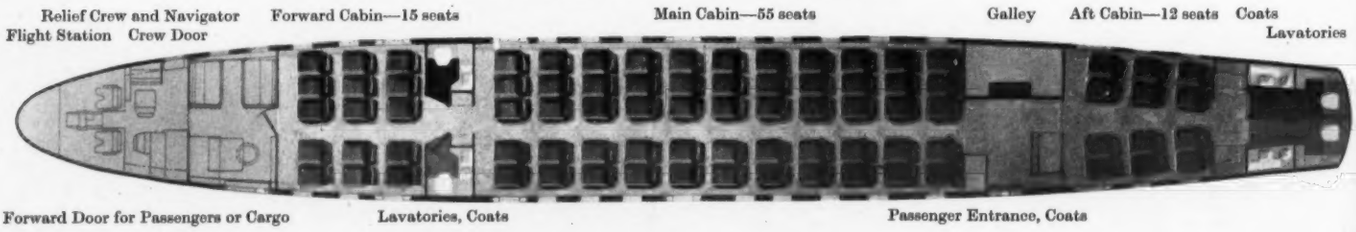
Note impression of cabin width created by the flat but amply high ceiling, and the feeling of structural integrity given by seamless carpeting and continuous flow of overhead racks.

New cabin retains individual spotlighting of chairs.

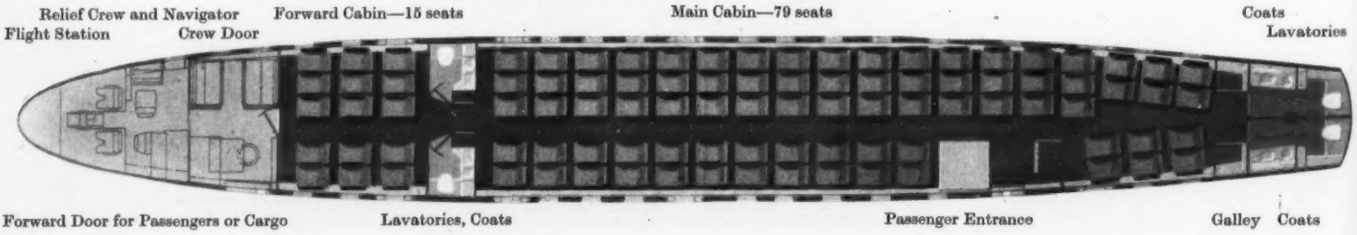
Typical of Dreyfuss designing is this limited-space washroom in the new "Super Constellation" cabin. Note the fingertip controls of the wash basins, the recessed compartments for towels and soap, sidelighting of the basin area, and the tilted mirror directly above the basin.

Intercontinental Basic Interior ; 59 passengers, including 4 in lounge

Intercontinental Tourist Interior ; 82 passengers



Intercontinental Tourist Interior ; 94 passengers



Will Montreal's "Aviation Building" Lose its Tenants?

At the end of the war a new capital city was created : Montreal, Canada, became the centre of civil aviation. The inter-governmental International Civil Aviation Organization took up its headquarters there, and its little sister, the International Air Transport Association, which was born shortly after, followed it. The Canadian Government welcomed the honour of playing host to the two major organizations of international civil aviation, and at considerable expense it erected the " International Aviation Building " in Montreal, which was occupied in 1950.

It was not the scenic beauty of Montreal nor the hard currency of wealthy Canada which decided in favour of Montreal. The choice of the headquarters site for I.C.A.O. was a delicate problem at the time. On the one hand there was the powerful American air transport industry, which had grown enormously as a result of the experience it had gained during the war ; on the other hand there was Europe's so-called air transport which had virtually been wiped out by the hostilities and continued to exist in name and by tradition alone. South America and Australasia were too much along the periphery of world air transportation. The choice of Montreal was intended to be a kind of fool-proof solution to every problem, for it was also believed that the Russians, on whom the people behind I.C.A.O. were still counting, would prefer Canada to all-powerful America.

However, in the course of time it became apparent that Montreal was not the ideal place for these important bodies after all. The Russians refused to play. Europeans, South Americans, Africans, air transport people from the Middle and Far East found the trip to Montreal tedious and costly . . . and the Canadian dollar too sound. At regular intervals it was rumoured that both I.C.A.O. and I.A.T.A. were planning to move. Is this removal imminent ?

*

I.C.A.O. and I.A.T.A. are of direct interest only to a limited circle of air transport experts. All the same, the two organizations have arrived at a point where news about them slips into the daily press from time to time, simply because air transportation has become a factor of day-to-day life. A few days ago we had a visit from a well-known international civil aviation expert who asked us with a smile : Why is it that the press—your magazine included—devotes so much more space to the less important, private I.A.T.A., the association of the international airline companies, than to the official, world-wide I.C.A.O. ? After all, I.C.A.O. exercises such a decisive influence on the whole of the world's air transportation . . . The question gave us food for thought, and we decided to do better in future. We shall now endeavour to describe some of the reasons behind this attitude of the press.

*

Will I.C.A.O. move out of the International Aviation Building in Montreal ? It moved in in June 1950.

I.A.T.A. is a very generous organization ; it is the representative body of the world's major airline companies. It is a private association, even though many of its member companies are government-owned or government-controlled. Member companies are represented by private individuals who are much more flexible and mobile than civil servants. They can convene conferences whenever they like, and they can hold them where they like. Mostly they meet quite ostentatiously at fashionable resorts, the names of which are household words. They organize many of their meetings at first-class hotels, and they surround them with balls and banquets, and the delegates bring their decorative ladies along. Furthermore, I.A.T.A. has a very popular Director-General, a master of ceremonies and an efficient propagandist.

And I.C.A.O. ? It is a kind of international ministry of civil aviation and simultaneously, if you wish, a kind of parliament of the civil aviation authorities of the various countries. This ministry or parliament is presided over by an extremely scrupulous, very able, unostentatious expert, who is assisted by a Secretary-General of similar mould. The top echelon is completed by a Permanent Council which meets in Montreal and is composed of 21 delegates from 21 countries. The staff of I.C.A.O. consists of about 450 international officials at Montreal, appointed from the 57 member countries. While I.A.T.A. has its own branch offices in New York, London, Paris and Singapore, I.C.A.O. maintains considerably more important and larger regional offices, namely, a European and African office in Paris, a Far East and Pacific office in Bangkok, a Middle East office in Cairo, and a South American office in Lima ; the North American office is included in I.C.A.O. headquarters in Montreal. These regional offices are of decisive importance to I.C.A.O. Their heads function as ambassadors to the states in their areas, and their offices are the focal points of the regional technical conferences. They forward their recommendations to the parliament in Montreal, and they supervise—in cooperation with the governments concerned—the enforcement of the decisions taken by I.C.A.O.

This is roughly the role played by I.C.A.O. The question of why the press neglects this organization is still unanswered.

We do not believe that this is due to a sin of omission on the part of I.C.A.O., but we feel that the organization simply has become a victim of a constellation of our time. I.C.A.O. is a world organization, a public organization which is affiliated to the United Nations. The United Nations organi-

The I.C.A.O. Council, composed of delegates from 21 countries, in session at I.C.A.O.'s Montreal headquarters.

Dr. Edward P. Warner, President of the Council of I.C.A.O., who has guided the destinies of the International Civil Aviation Organization since its creation, will retire after the 1953 General Meeting.

A few months ago, E.C.R. Ljungberg, of the Swedish Civil Aviation Board, was appointed Secretary-General of I.C.A.O.

zation itself encounters a certain lack of interest and lassitude on the part of the public. They all suffer from this negative attitude today : United Nations, UNESCO, European Council, I.C.A.O. and the rest. Why . . . ? The old League of Nations committed suicide in the thirties, and the successor organizations—whose achievements have been somewhat disappointing so far—do not display those brilliant names and personalities who gave the old League of Nations its glitter, at least in its early stages. When statesmen of the renown of Briand, Stresemann, Austen Chamberlain, Aloisi, Titulescu, Benes, Litvinov—to mention only a few—spoke from the tribunes of the League of Nations, they captured the attention of the world. Today ? The average newspaper reader hardly even glances at the reports on the U.N.'s debates.

I.C.A.O., too, suffers the effects of the general apathy.

*

This lack of interest is unjustified, for, but for the work of I.C.A.O., world air transport would still be in a primitive state, with or without I.A.T.A. There would be no North Atlantic air services, which were made possible only after I.C.A.O. had persuaded its member countries to commission 25 Atlantic weather ships, ten of which cruise in well-defined areas of the North Atlantic 24 hours a day. Similar weather ships will be placed in service in the Pacific in the near future. There are thousands of other reasons why world-wide air transport would not be possible without I.C.A.O. It was I.C.A.O. which in fourteen annexes to the Chicago Convention created standards and recommended practices for international air navigation and safety aids. It has worked out standards for the international certification of transport aircraft, without which no aeroplane would be allowed to fly from one country to another or from continent to continent. It drew up and is continuously evolving standards for the construction of airports and for their equipment. It has established regulations for the training and licencing of flying personnel. It has been I.C.A.O.'s duty to enforce the introduction of a unified code in the world's radio navigation aids. It is diligently working on the standardization of international air law. Finally, it is I.C.A.O. which endeavours to place within a standardized framework every technical innovation—including the use of jet aircraft—to permit its practical application.

This enumeration is incomplete, but it nevertheless shows the air traveller who it is that has enabled him to fly around the globe in safety. It is I.C.A.O.

*

The life of I.C.A.O. has not always been easy. It is neither a research institute that may content itself with theoretical investigations and platonic recommendations ; nor is it an executive national aviation authority which can issue rules and regulations, since it is an organization comprising 57 sovereign states. These 57 countries make up about two-thirds of the earth's surface and furnish about 95% of the volume of international air traffic. The I.C.A.O. Council and its 21 members, who are more or less responsible for all decisions by I.C.A.O., is composed as follows : three government delegates from North America, three from the South American countries, three from Asia, nine from Europe, two from Africa and one from Australasia. Herein lies a weakness, as you will have noticed : missing are the delegates from the Soviet Union and Red China. But you can picture how difficult it must be at times to manœuvre not only among the 21 Council members, but also among the 450 members of the staff. These do not speak different languages only from a philological point of view. At times they feel like little diplomats who ultimately can rely on the backing of their own governments.

Because all these men are government delegates or civil servants, and because civil servants must watch their expenses, and because in addition I.C.A.O. has to explain to 57 member states its annual expenditure of about $2,500,000, it is easy to imagine that neither funds nor inclination are left for entertainment and formal representation. Thus I.C.A.O. finds it relatively difficult to blow its own publicity trumpet.

*

The heads of I.C.A.O. regional offices resemble ambassadors to the nations in their areas. Picture shows the head of the Paris office (left), Lionel Bedin, formerly a Commander in the French Fleet Air Arm, who has been active in aeronautics for 25 years; he has logged more than 5,000 hours in the air and served with the Air Transport Command of the U.S. Air Force during the war.

Let us now revert to our starting point : is a decisive change planned for I.C.A.O.?

On November 14th, 1952, it was officially announced that the next full-dress Assembly of I.C.A.O. would take place at Brighton, at the invitation of the British Government, and would last about four weeks from June 16th, 1953. It will be the first session since 1950 at which all major problems of civil aviation —technical, economic and legal—will be discussed. More than that is involved, however. At stake is the future of I.C.A.O., for the agenda includes two items of cardinal importance : election of a successor to the President of the Council, who has been in office since the creation of I.C.A.O., and a vote on the proposal to move I.C.A.O.'s headquarters elsewhere.

Dr. Edward P. Warner, who has been presiding over the destinies of the Provisional Civil Aviation Organization and later I.C.A.O. since the days of the Chicago Convention, wishes to retire. His wish is comprehensible. His high sense of duty and his integrity have driven him to overwork in the course of many years. His inclination towards profound theoretical study has not always made his life very easy. He heads an institution which every day sends several tons of paper printed in three official languages to every corner of the earth. The archives of all airfaring nations know something about that. Apart from this, it cannot always be easy to extract—with tact *and* energy—the necessary decisions from those 21 Council members and 450 officials from 57 countries.

Edward P. Warner wants to go. It is not at all certain that his successor will be a European, because Secretary-General Ljungberg, a Swede, already represents the Old World at I.C.A.O. headquarters. Some sources believe that an American, E.R. Marlin, who recently was appointed chief of the Technical Assistance division, will be elected, but the accuracy of this forecast cannot be gauged. It is certain that Marlin is young and that Marlin has personality. Let us wait and see.

It is possible, however, that I.C.A.O. will leave Montreal at the same time as Warner. The inconveniences mentioned at the beginning, namely, the high cost and the remoteness of Montreal, would thus be eliminated. A new civil aviation centre would have to be chosen, and here again a hint has been circulating—Lisbon, capital of Portugal. Lisbon lies at the cross-roads of the Old and the New World, between the North and South Atlantic. Who knows ?

What would happen if I.C.A.O., under a new President, left hospitable Canada ? It certainly would not harm anybody, for the Canadian Government can easily afford the luxury of leaving the International Aviation Building vacant or, if it likes, letting it to somebody else. It would not undermine the importance of Canada as an airfaring nation : this importance is growing daily anyway.

A single additional question would then become acute : I.A.T.A., I.C.A.O.'s little sister and always dependent upon it, might see its old wish fulfilled and take up quarters in Europe . . . Perhaps in Geneva.

I.A.T.A.'s New Members

Just before the Eighth Annual General Meeting of the International Air Transport Association in Geneva last September, it was announced that five new airlines had joined I.A.T.A., bringing to 67 the total number of members. Three of the companies are big French independent carriers, namely, *Air Algérie, Transports Aériens Intercontinentaux* and *Union Aéromaritime de Transport*, all of which conduct intensive operations between France and her overseas territories, chiefly Africa. The other two are rapidly expanding Far Eastern operators with close connections with European carriers, *Garuda Indonesian Airways* (KLM) and *Malayan Airways* (BOAC).—This brief tabulation completes the last " Airline Who's Who " published in *Interavia Review* for September, 1951.

Air Algérie (Compagnie Algérienne d'Aviation S. A.), 46 Bd. St. Saëns, ALGIERS.

M. Jean Lignel, Chairman and Director General, Air Algérie.

Air Algérie is one of the most active and most rapidly developing French air carriers working beside and in cooperation with the big national airline, Air France, which originally held a financial interest in the company. Its initial capital of Fr. frs. 28,000,000 had to be increased to Fr. frs. 168,000,000 in a relatively short time to enable the company to cope with its expanded activities. Today Air Algérie operates over unduplicated routes totalling 15,800 km. Chairman of the Board and Director-General is Jean Lignel, the well-known French airman and aircraft designer. Last June, Compagnie Maritime Fraissinet acquired 98 % of Air Algérie's capital shares.

CAPITAL	MANAGEMENT	AIR FLEET	PRINCIPAL ROUTES
Initial : Fr. frs. 28 million Present : Fr. frs. 168 million Majority held by Cie. Maritime Fraissinet	Jean Lignel, Chairman and Director-General Leon Adida, Managing Director Colonel Alias, Ops. Manager Herbert Wolfe, External Relations	6 SO 30 « Bretagne » 12 Douglas DC-3 1 Bréguet 761 19 Total	Algiers to : Paris — Marseilles — Toulouse — Lyons — Perpignan — Clermont-Ferrand — Bordeaux — Geneva — Basel/Mulhouse — Palma — Palma-Marseilles — Oran-Paris — Constantine-Bone — Philippeville-Paris

Compagnie de Transports Aériens Intercontinentaux (TAI), 23, rue de la Paix, PARIS 2e.

Left, *Paul Bernard, Chairman of T.A.I.*, right, *Paul Genain, Managing Director.*

TAI was formed on June 1st, 1946, and with old Junkers Ju-52 and Bristol 170 " Freighter " aircraft immediately began to participate in the lucrative post-war services between the French Metropolis and French North Africa. Gradually the competition of surface shipping with newly-built vessels became stiffer in the Mediterranean area, and to meet it the company had to acquire more modern flying equipment. By 1947 it was operating a uniform fleet of Douglas DC-4s. Pursuing its policy of continuously improving its equipment, TAI later bought four four-engined SE 2010 " Armagnac " airliners and now has also three Douglas DC-6B's on order for delivery next spring. Operations gradually increased to 140,000,000 passenger-km and 3,450,000 cargo-ton-km in 1951, and the rate of equipment utilization has now reached 8 hours of flight per aircraft per day. Length of route network is 45,000 km.

CAPITAL	MANAGEMENT	AIR FLEET	PRINCIPAL ROUTES
Initial : Fr. fr. 20 million Present : Fr. fr. 100 million, partly held by employees	Paul Bernard, Chairman Paul Genain, Man. Director Gen. Fayet, Dep. Man. Director Colonel L. Aubrée, Ops. Manager M. Destenay, Chief Pilot	5 Douglas DC-4s 4 SE 2010 « Armagnacs » 9 Total 3 Douglas DC-6B on order	Paris to : Saigon — Antananarivo — Cameroons — Gabon — Casablanca-Abidjan — Casablanca-Canary Isl.

Union Aéromaritime de Transport (UAT), Compagnie Française de Navigation Aérienne, 19 Boulevard Malesherbes, PARIS.

UAT was established on October 13th, 1949, as a subsidiary of Compagnie des Chargeurs Réunis, the French shipping line operating mainly down the African West Coast, but Air France is understood also to hold an interest in the company. The company started its activities by operating converted B-24 " Liberator " bombers from Paris to Cayenne and Caracas. With expanding operations, it soon began to cast around for more modern equipment. At present it has five Douglas DC-4s in operation, but it has engaged on an ambitious re-equipment programme involving three de Havilland " Comets " and three D.H. " Heron " feeder liners as well as three Douglas DC-3s. Present route network totals 75,000 km.

CAPITAL	MANAGEMENT	AIR FLEET	PRINCIPAL ROUTES
Initial : Fr. frs. 400,000 Present : Fr. frs. 10 million Majority held by Chargeurs Réunis	Louis Vidal, Director-in-Charge M. Combard, M. Loubry : Joint Managing and Technical Directors M. Veillard, Ops. Director	5 Douglas DC-4s On Order : 3 D.H. « Comets » 3 D.H. « Herons » 3 Douglas DC-3s	Paris to : Abidjan — Pointe Noire — Saigon

Garuda Indonesian Airways N.V., 15 Djalan Nusantara, DJAKARTA (Indonesia).

On March 31st, 1950 the Indonesian Government and K.L.M. Royal Dutch Airlines signed agreements which formally established Garuda Indonesian Airways as the Indonesian flag carrier. The initial capital, equivalent to 30,000,000 rupiah (Indonesian guilders), was subscribed at a price of 300 % par (!) in equal proportions by KLM and the Indonesian Government, and KLM received a contract to manage the new line until 1960. The company has expanded steadily since its formation, chiefly as a result of the addition of modern flying equipment (Convair 240's) : in 1951 it carried 293,000 passengers, a figure which rose to 297,000 the following year. Revenue kilometres increased from 8,264,000 in 1950 to 9,186,000 in 1951 ; the network of unduplicated routes at present measures 25,146 km. Garuda is planning new services to India, Siam and Australia.

CAPITAL	MANAGEMENT	AIR FLEET	PRINCIPAL ROUTES
30,000,000 Rupiah 50% Govt. 50% KLM	R. Soejominhardjo, Chairman Dr. E. van Konijnenburg, Man. Director Dr. C. A. Mochtar, Dep. Man. Dir.	22 Douglas DC-3 8 Convair 240's 8 Convair « Catalinas » 38 On order : 14 D.H. « Herons »	Djakarta to : Singapore — Manila — Surabaya — Amboina

Malayan Airways Limited, c/o Mansfield & Co., Ocean Building, Collier Quay, SINGAPORE.

Malayan Airways was formed early in 1947 and started operations in May of that year. Founders were two shipping companies, The Ocean Steamship Co., of Liverpool, and The Straits Steamship Co., of Singapore. The management is provided by Mansfield & Co., the two companies' Singapore agents, and B.O.A.C. holds a 10-percent interest in the capitalization. Malayan Airways recently formed a subsidiary, *Sabah Airways*, which operates in Sarawak and North Borneo. In addition, the company manages the Federation Air Services on behalf of the Malayan Government, operating five de Havilland " Beavers " between small towns in the Federation of Malaya.

CAPITAL	MANAGEMENT	AIR FLEET	PRINCIPAL ROUTES
Malay $2,500,000 10 % B.O.A.C.	F. L. Lane (Director & Manager, Mansfield & Co.), Chairman J. Linstead, BOAC Representative Capt. R. P. Mollard, Man. Director Capt. D. W. Fenton, Chief Pilot A. G. Bochan, Traffic Manager	11 Douglas DC-3s 2 D.H. 89 « Rapides » 5 D.H.C. « Beavers » 18	Singapore to : Malaya — Sarawak — Indonesia — Fr. Indo-China — Thailand — Borneo — Malacca

Press Mosaic

Public Relations officials, air ministry press chiefs, associations, industries and other concerns have acquired an assistant of inestimable value. Today it is scarcely possible to open any daily or weekly paper without coming upon some item of news connected with aviation.

A practical illustration of this is provided by the following brief press review.

● *" Colliers ", November 29th, 1952.*—" The Budget Battle " *by George F. Eliot.*

Using the sub-title " Where we're losing to the Reds ", the well-known military journalist George Fielding Eliot examines the weaknesses in Western armament, in particular in the United States, and gives the answer in his introductory remark : " Because our budget operates on an annual hand-to-mouth basis, Russia has the edge in military power. To pull ahead, we need a ' Four-Year Plan ' of our own. "—Eliot considers that " the first and most urgent task of the new President is to establish the armed power of the United States on a permanent basis." The President is elected for four years, and he should plan for these four years. As modern weapons take many years to develop and produce, but soon become obsolete, the principle of confining the military budget to a single year is untenable. The Russians have their Five Year Plans. They are now working on their fifth, and have had the best of experience with them. The MiG-15 was developed in 1946, during the fourth Five-Year Plan. By 1951, the beginning of the fifth Five-Year Plan, it was in full production. And when the sixth Five-Year Plan starts in 1956 the Russians will doubtless have a whole series of other heavy weapons ready for use.

● *" Journal de Genève ", December 6th, 1952. —From a report by the paper's German correspondent Georges Blun.*

" . . . From the discussions that have taken place since his election between President-elect Eisenhower and the (retiring) American High Commissioner in Bonn, it may be inferred that the new President will ' play the German card ' more strongly than his predecessor. It would appear that the representatives in Paris of the future German Ministry of Defence (Blank Office representatives at the European Defence Community) have already been informed of this. For his part, Mr. Eisenhower is expected to make it clear to Paris at the appropriate moment that he intends to insist on the rearmament of the Germans. This would mean that the French would be faced with the choice of a European Army or an independent German national army... In conversations between American and German officers at Bad Godesberg it is said to have been hinted that the United States was prepared to provide DM 12,000,000,000 for the twelve new German divisions, so that they could be supplied with up-to-date equipment. The Americans hold within their powerful hands the fate of the free nations of Western Europe... "

● *" Tribune de Genève ", December 6th, 1952. —From a report by Berlin correspondent Harold.*

" ... Meanwhile the ' Blank Office ' (future German defence ministry.—Editors) has begun preparations for the German contin-

gents. A thankless task, as this pseudo defence ministry is an absurdity... not only because this work, begun two years ago, should not have started until after ratification of the treaties... The Blank Office has condemned Prussian militarism and proposes to form ' citizen soldiers '. But it has forgotten that it takes centuries to make a citizen in uniform into a valuable soldier... The Americans, who also have something to say in the matter, are supposed to have said :

Theodor Blank, *West Germany's Security Official—in other words future West German defence minister—disapproves of Prussian militarism and wants to form " citizen soldiers ".*

We need the same soldiers as we knew in the last war, who gave us so much trouble ! —But such soldiers would have to be trained on the old Prussian model... This explains French fears and British hesitations. Let us hope that the Americans will be able to control the spirits they are conjuring up today."

● *(Exceptionally !) " Interavia Air Letter ", December 6th, 1952.—Air transportation.*

" Juan T. Trippe, President of Pan American World Airways, was awarded the Order of Merit by the German Federal Republic on December 2nd ' for his extraordinary services to the peaceful recovery of that country '. The citation referred to P.A.A.'s help during the Berlin airlift and the aid now being given in maintaining air communications between West Berlin and the rest of Western Germany.—It is not beyond the realm of possibility that there is more behind the award than appears on the surface : P.A.A. is probably playing godfather to the new German Lufthansa in more ways than one, including the delivery of twin-engined ' Convair-Liners ' from its own fleet. A few months ago in Bonn Trippe and T.W.A.'s Ralph S. Damon were engaged in what could be called a ' tug-of-war ' in which—the distinction should not be overlooked—Trippe apparently was not the loser."

● *" Der Spiegel ", December 3rd, 1952.—Germany, Youth.*

" Dr. Hans-Christoph Seebohm, Federal Transport Minister and responsible for Germany's future air transportation, has added to his already extensive duties—land, sea and air transport—that of ' Honorary President of the German Anglers' Association ' (Air Minister Hermann Goering was Chief Huntsman in Nazi Germany.—Editors). In this capacity Seebohm has sent a circular to the ministers of education and culture in the various Länder calling on them to encourage greater interest in angling among young people . . . This led the competent minister in Lower Saxony to issue an order which reads in part as follows : ' In the absence of other preoccupations I welcome the Transport Minister's suggestion . . . I appoint my Sports Chief as Chief Angler . . . The projected nerve clinic at Göttingen University will set aside three rooms for a new section to treat young anglers . . . Under the political education programme anglers' lines will be decorated with the proud emblems of Germany's past. Waters in which fish are found to be immune to this will be reported to the Chief Angler for political investigation."

● *" Ogonek " (Russian periodical), December 1st, 1952 quoted by " Die Zeit " (Hamburg), December 4th, 1952.—" Trip to the Moon.".*

" . . . The Soviet flag will fly on the moon. Artificial satellites will circle the earth sixteen times a day, each with a red star. The Russian magazine " Ogonek " publishes an article by A. Sternfeld in which he forecasts that all these plans can be put into practice in the next fifty years. At an altitude of 170 miles the artificial satellites will race round the earth at 17,270 m.p.h. on a trajectory 8,257 miles in diameter. A ' cosmodrome '—a space travel airport—will be built near the town of Kaluga, southwest of Moscow . . . It will be possible to fly from Kaluga to the artificial satellite in four hours, and thence to the moon in five days . . . "

● *" Across the Space Frontier " (see also Book Reviews), in " Time ", December 8th, 1952—Science : " Journey into space ".*

Dr. Wernher von Braun, father of Germany's V-2 rocket (Peenemünde) and today working for U.S. Army Ordnance at its guided missile centre at Redstone Arsenal, Huntsville, has made himself spokesman for an American earth satellite programme, to which " Time " devotes a full five-page article. In " Across the Space Frontier " von Braun writes : " Within the next 10 or 15 years, the earth can have a new companion in the skies, a man-made satellite which will be man's first foothold in space." Von Braun envisages a " nylon doughnut " 250 feet in diameter, prefabricated, but capable of assembly on the spot. This would make an ideal observation platform, from which for example " every change of the Kremlin guard " could be watched . . . or any point on earth bombed with the utmost precision . . . Such an artificial moon would be an ideal jumping-off base for trips to the real moon, to Mars, etc. Dr. von Braun estimates the cost of such an artificial satellite at " only " $4,000,000,000, or 8% of the present American defence budget.—However, Von Braun's proposals have aroused a certain amount of scepticism even in the United States. Dr. Milton Rosen of the Naval Research Laboratory, Washington, is his most articulate critic, branding Von Braun's projects as likely to lead to a " gigantic fiasco ". Another expert says of Von Braun " This is the man who lost the war for Hitler . . . His V-2 was a great engineering achievement, but it had almost no military effect . . . Now he is trying to sell the U.S. a space flight project disguised as a means of dominating the world."

Dr. Hans-Christoph Seebohm, *Transport Minister in the West German Federal Republic, who has been appointed Honorary President of the German Anglers' Association, with (left to right) his colleagues Hellwege and Storch.*

● *" Time ", December 1st, 1952, a reader's letter.—A Question of Credentials.*

. . . A wild speech by the German " Papa Ramcke ", the ex-paratroop general, at an S.S. meeting at Verden recently aroused considerable attention in the world's press and among the German public. *Time* publishes a letter from one of its readers which shows that Ramcke has always been a difficult customer.—When the 13th Regiment of the U.S. 8th Division under Brigadier General Charles D. W. Canham—as fate would have it, also a parachute general, recently given the nickname " The Jumping Grandpa "—went to accept surrender from Ramcke and his staff in their bunker 75 feet under ground near Brest on September 19th, 1944, Ramcke haughtily asked to see his credentials. Canham merely pointed to the Tommy-guns behind him : " These are my credentials." Apparently it was sufficient.

● *" Der Spiegel ", November 26th, 1952—From the " Hohlspiegel ".*

" . . . American airmen at Thule Air Force Base, Greenland, can listen to broadcasts from Russia every evening. A woman speaker tells them in the purest American slang to go home and get warm . . . One evening this charmer told the commandant of the base that one of his runways was not properly lit. She even told him which one . . . And she is said to have been right. "

What's in the Air ? *

SERVICE AVIATION

● Analysing the combined air, land and sea exercises (" Operation Mainbrace ") by N.A.T.O. forces off the Norwegian and Danish coasts, the U.S. Air Force Association's magazine " Air Force " states that the exercises clearly demonstrated that *carrier task forces cannot operate effectively in the North Sea*, because of their vulnerability to submarines and mines, the frequency of bad weather and the lack of space for manoeuvring.

● *Cuts in aircraft orders for U.S. Air Force and Navy*, which were causing some concern towards the end of 1952, appear from the latest reports to be more in the nature of a conversion to more *up-to-date aircraft types*. For example the U.S. Navy has ordered the A2D-2 propeller turbine low-level attack aircraft (successor to the Douglas AD-5) into production six months before the original date planned.

● The U.S. defence estimates for 1954 include an item under " Navy " for a *third aircraft carrier of the Forrestal Class* (59,000 tons).

● The *Dutch Air Force* received six *Republic F-84G " Thunderjets "* at the end of November 1952—the first *jet fighters flown from the United States* under the Mutual Defence Assistance Programme.

● After a visit of inspection to Korea *General Hoyt S. Vandenberg*, U.S. Air Force Chief of Staff, confirmed that the Red air units in Korea now have Russian-built *Ilyushin Il-26* twin-engined medium bombers.

● Details of the organization of the " *East German Air Police* " have been published by the West German Government. Present strength is about 5000 officers and men, who have been training on Russian aircraft for several months. Headquarters are in Berlin-Johannisthal. Production of German-designed aircraft is also apparently planned.

AIRCRAFT INDUSTRY

● *Aircraft production in the United States* is now between *1000 and 1100 machines a month*, the Aircraft Industries Association reports. This rate is to be maintained through 1953 and 1954. *Order backlog* on June 30th, 1952 : $14,507,000,000 ; 1951 : $9,469,000,000 ; 1950 : $2,987,000,000.

● At the beginning of December *Douglas Aircraft Co.* had orders on its books for 58 *DC-7 transports*, quantity production of which has recently begun.

● The well-known American woman pilot *Jacqueline Cochran*, wife of financier and aeronautical industrialist *Floyd Odlum* (President of Atlas Corp., the investment concern, controlling share-holder in Convair, Northeast Airlines, etc.) has joined *Canadair Ltd. as part-time flight consultant.*

● *John K. Northrop*, founder and President of Northrop Aircraft Inc., resigned at the end of November for health reasons. He has been succeeded by Oliver P. Echols, hitherto Chairman of the Board. Northrop is known among other things for his championship of the flying wing.

● The first production *Vickers-Supermarine " Swift "* jet fighters are nearing completion and are to be delivered to the R.A.F. *early in 1953.*

AIR TRANSPORTATION

● " *Round the world by tourist class* " is the promise made to air travellers by the International Air Transport Association at the close of its Traffic Conference at Cannes (October 21st-November 27th 1952). *Tourist class services* from *April 1st, 1953*, in Europe and to the Middle East ; from *October 1st, 1953*, to the Indian Ocean countries and between Europe and South Africa ; from *April 1st, 1954*, to the Far East.

● The decision by *William A. Patterson, President of United Air Lines*, to reduce the number of seats in the Douglas DC-4s operating U.A.L.'s tourist services from 66 to 54 " for safety reasons " came as something of a bombshell in American air transport circles. The Civil Aeronautics Board has stated that such a reduction in seating capacity would inevitably lead to reduced earnings and to subsidies, or to suspension of coach services.

● The Irish Airline *Aerlinte Eireann* has signed an agreement with the American air cargo company *Seaboard & Western* for a joint trans-Atlantic tourist class air service between Shannon and New York or Boston, to be inaugurated on April 1st, 1953.

● *The Preparatory Committee for German Air Transport* has completed its work. The *Gesellschaft für Luftverkehrsbedarf*—predecessor to the new Deutsche Lufthansa—is to be officially founded on January 6th, 1953.

FIRST FLIGHTS

● The *SB.5 swept thin-wing research aircraft* built by *Short Bros. & Harland Ltd.*, Belfast, began flight tests on December 2nd. The SB.5 (Rolls-Royce " Derwent ") is to be used to investigate the low-speed behaviour of sharply swept extra thin wings (thickness 6%).

● It has just been announced that the prototype of the *Macchi M.B. 323* two-seater all-metal low-wing trainer (600 h.p. Pratt & Whitney R-1340 " Wasp " engine) made its first flight test on October 7th. Macchi is now reported to be working on a version with nose wheel (designation M.B. 323 T).

● Flight testing of the *Piaggio P. 150* military trainer began recently.

● The *Max Holste MH 1521 " Broussard "* general purpose aircraft has started flight testing at Rheims airfield, piloted by P. Henry. (Single-engined high-wing monoplane ; 455 h.p. Pratt & Whitney R-985 " Wasp Junior " engine.)

NEW AIRCRAFT

● *SNCA du Nord* has worked out a project for a military transport *(Nord 3100)*, a development of the twin-engined Nord 2501. Engines : two Bristol " Proteus " propeller turbines and two small Turboméca jets as take-off aids. With a gross weight of 36 tonnes, the Nord 3100 could carry a payload of 13 tonnes over a stage of 930 miles (1500 km) ; cruising speed around 375 m.p.h. (600 km/h).

● *SIAI-Marchetti* has announced two projects for twin-engined transports, the SM.112 and the SM.115 " Canguro ". Whereas the SM.112 is still in its early stages of development, the following details can be given for the SM.115 : all-metal high-wing monoplane with twin tail booms, triple fin-and-rudder unit, retractable nose-wheel undercarriage ; engines : Pratt & Whitney R-2800 CA.18 or CB.17 " Double Wasps " or Bristol " Centaurus 661s " ; gross weight 21 tonnes, normal payload 7.5 tonnes.

ENGINES

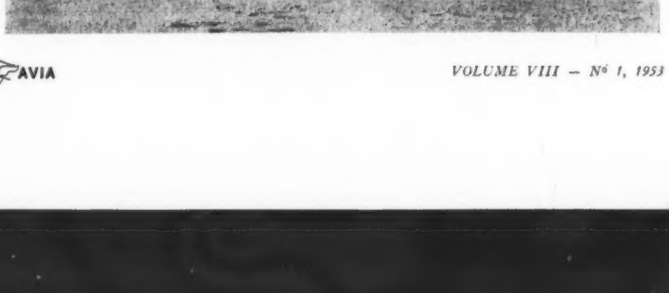
● *Pratt & Whitney T-52* is a propeller turbine of 8500 s.h.p. under development.—Pratt & Whitney has also published first details of a new turbojet, the *P & W J-75* (development of the J-57) ; take-off thrust is said to be " considerably above 10,000 lbs (4535 kg) ". Some sources estimate its power at 15,000 lbs (6,800 kg), and others at as much as 20,000+lbs (9,000+kg).

● Readers are already acquainted with reports on the development of new rocket engines at Armstrong-Siddeley, Bristol, de Havilland and Fairey. American sources now mention the *Armstrong-Siddeley " Screamer "* and *de Havilland " Spectre "* ; both engines are said to have been designed to the same specifications and to be controllable over their whole power range. No performance details are available.

* Extracts from " Interavia Air Letter ", daily international news digest, in English, French and German. All rights reserved.

Short SB.5 research aircraft, with thin swept wing. Angle of sweep adjustable on the ground.

Macchi M.B. 323 two-seater trainer with 600 h.p. Pratt & Whitney R-1340 " Wasp " engine. Span 40ft.8ins ; length 32ft.2ins ; wing area 236.8 sq.ft. Gross weight 4960 lbs ; max. speed 232 m.p.h. service ceiling 24,600 ft.



Book Reviews

Across the Space Frontier, edited by Cornelius Ryan. — Publishers (U.S.A.) : The Viking Press, New York, 1952 : 147 pages, price $3.95 ; (U.K.) : Sidgwick and Jackson, price 21s.

This superbly illustrated volume is a compendium of articles by six top-ranking experts in the field of space research, based on a symposium which appeared last summer in Collier's magazine. Its main theme is the feasibility—and even the pressing strategical necessity—of constructing an artificial satellite or " space station ". Many would be prone to regard *Across the Space Frontier* as what is commonly known in publishers' jargon as " S-F "—scientific fiction—were it not for the names of the contributors : Dr. Wernher von Braun, Technical Director, U.S. Army Ordnance Guided Missile Development Group ; Dr. Heinz Haber, Assistant Professor of Astrophysics, Department of Engineering, University of California ; Dr. Fred L. Whipple, Chairman, Department of Astronomy, Harvard University ; Willy Ley, the German missile and rocket expert, founder of the German Rocket Society ; Dr. Joseph Kaplan, Professor of Physics, University of California ; Oscar Schachter, Deputy Director, Legal Department, United Nations.

Dr. von Braun, co-designer of the German World War II V-2 rocket missile, contributes a readable but complete analysis of the basic principles of space-flight, describing in some detail the design of a giant rocket, calculated to carry the components of a space station into a satellite orbit 1,075 miles (1,730 km) above the earth. Dr. Haber, a member of the U.S. Air Force's Department of Space Medicine, discusses the physiological and psychological problems confronting human existence and survival under higher acceleration and gravity-free space conditions. Willy Ley describes the construction and operation of the space station as such, including the creation of an artificial " gravity " component by means of axial rotation.

The remainder of the book is devoted to the purely astrophysical, astronomical and—last but not least—juridical aspects of space travel, the latter under the heading : " Who owns the Universe ? "—a problem no longer as academic, perhaps, as it appeared 50 years age . . .

Across the Space Frontier is first-rate reading and a worthwhile addition to the library of any enthusiast—whether the adolescent " space cadet " outfitted by Macy's in New York . . . or the more mature and scientific-minded astronaut. (English.) Ma.

Air France Revue, published by Air France, under the patronage of the Prime Minister. Summer 1952 : " 1901-1952, Palette de Souvenirs ".

Air France's semi-annual Review is too well known to require praise here ; it is one of the best illustrated journals in French aviation, or indeed anywhere. However the latest volume " Palette de souvenirs " gives such an excellent picture, in both presentation and content, of the half-century of powered flight, that it merits a special word.

Der hochrote Hahn, by Hans Rumpf. — E. S. Mittler & Sohn, Darmstadt, 1952.

A description by the Inspector General of the German Fire Services of his experiences during World War II, covering the thousand-bomber raids and the nights of terror in Cologne, Essen, Kassel, Hamburg, Berlin, Dresden and 140 other German towns, the systematic destruction of the armament industry and communications, the desperate efforts of the defences and the fire services. — The author has made an honest attempt at objectivity and has succeeded in producing the most comprehensive book on the mass air raids and their catastrophic consequences for the whole of Europe that has yet been published. (167 pages ; German.) Ri.

Durch Höhen und Tiefen jagt ein Herz.

By Theo Osterkamp. — Verlag Kurt Vowinkel, Heidelberg. 20 illustrations. DM. 12.80.

The author was a pilot during World War I and received the highest German award for bravery, the Pour le Mérite. After the war he took up a civilian career, but as a successful pilot—to whom flying was everything—was called to the Reichswehr in the 'twenties. Surprisingly enough, the description of these years is the most attractive part of the book, since it reveals the real man in Osterkamp, who was not the stuff that Nazis were made of, though, in this love for flying, he did volunteer for the Air Force straight away in 1933. He honestly confesses to having believed in Hitler at first, but he did not join the Nazi Party. He was the oldest fighter pilot to go to the front on the outbreak of World War II, and was soon given command of a squadron. Later becoming commander-in-chief of the fighter units, he trained his successors Mölders and Galland. He appears to have disapproved of Goering from the start, and was dismissed and arrested by Hitler relatively early, in 1943.—The book describes a typical development : without Hitler Osterkamp and his colleagues would have been spared much disappointment and bitterness. Though tedious in parts, it will be read with interest by flyers. He.

Die Rettung Deutschlands. By Robert Ingrim. —Droste Verlag, Düsseldorf. DM 5.80.

The political writings of the Austrian-American journalist Robert Ingrim, who first made a name for himself by his book "After Hitler Stalin" published in the United States immediately after the war, have won for themselves an ever-increasing circle of readers, thanks to their logical attitude. This latest book of his has nothing whatever to do with aviation, except that it indirectly strongly supports the German treaty and hence Germany's incorporation in the West and her rearmament. Here Ingrim comes to some very original conclusions. The Soviet Union, he says, is not a new enemy, since it is thanks to its constant pressure that Western cooperation, a future United Europe and the " Atlantic " community in uniform are arising. The unification of the West however must be completed by a *rapprochement* between Germany and Poland, since the Poles too belong to the West. If Germany succeeds in conducting an active and constructive policy once again, nothing can ultimately hinder the unification of Germany. And a united Germany would be fulfilling its European mission if it brought Poland back into the Western community, thus providing a guarantee of peace. He.

Dem Himmel am nächsten. — By Günther Bloemertz.—Verlag der Europäischen Bücherei H. M. Hieronimi, Bonn. DM 11.—.

The wartime experiences of one of Germany's youngest fighter pilots, who joined the Luftwaffe at the age of 17, after some gliding instruction, was a lieutenant at 18 and in the front-line fighting at 19. Posted to Galland's group, the " Abbeville Boys ", when Germany was already on the defensive, he took part in the hopeless battle in the West. Shot down from over 29,000 ft., he managed to bale out of his burning aircraft, but was temporarily blinded. He returned to the front when barely recovered, was captured by the Russians, escaped and began his studies, writing this book in his spare time.—A picture of a typical young German who fought for his country in true patriotism but, in spite of his youth, recognized the weaknesses of the system in time. He.

The Capacity Problem—Under the Argentine Doctrine in International Air Law. By Prof. Dr. Enrique A. Ferreira.—No. 5 in the series of publications issued by the University of Cordoba Transport and Communications Institute, Cordoba, 1952.

Air law experts and delegates to international air traffic conferences are not unacquainted with the Argentine doctrine of air transport freedom and its originator Professor Enrique A. Ferreira. This doctrine was enunciated for the first time by the Argentine delegation to the first General Meeting of the International Air Transport Association (Montreal 1947). Since then Professor Ferreira has seized every possible opportunity of repeating his doctrine. He himself admits that it will not be easy to put his ideas into practice. He goes right back to first beginnings and even challenges the oldest principles of international law in order to arrive at a clear definition of terms, without which, in his view, all attempts at multilateral agreement on air transport freedom must inevitably fail.—In practice the Argentine proposal envisages a compromise between unrestricted freedom in world air transport and the unrestricted sovereign rights hitherto practised by individual States. Interavia has repeatedly stated that it cannot approve such compromise, since it regards complete freedom as a basic right to which the selfish interests of individual countries must be sacrificed. This is not to say, however, that Professor Ferreira's book is not well worth reading. He.

"*Jane's all the World's Aircraft 1952-53*". Compiled and edited by Leonard Bridgman. (Sampson Low, Marston & Co. Ltd., London, W.1. English ; 324 large pages ; £4.4.0.)

This forty-third issue of Jane's is thinner and yet contains more technical information than did the earlier copies. This compactness has been achieved, as Mr. Bridgman explains in his Preface, at the cost of two of the traditional features. The historical sections on service and civil aviation have been reduced, in the former case, to a token consisting of the national insignia of the World's air powers, and, in the latter, to a few pages on the international authorities and tabular information on the World's air lines. The economies effected by this severe pruning have not affected the essential sections on aircraft and engines. Even so, with the price of four guineas, it seems rather hard to lose so much reference information when the volume carries almost one hundred pages of advertising.

A new feature to be highly commended is a general index covering not only this volume, but the six preceding editions as well. The list of current F.A.I. records and first flights made between 1st June 1951 and 31st May 1952 are most useful references.

It is, however, to the aeroplane section that almost every recipient of a new Jane's turns at once. The body of the book is current to about June 1952 and addenda pages include the revelations of Farnborough, as heretofore. The number of photos new to Jane's and hitherto unpublished elsewhere is once again remarkable. The inclusion of three-view drawings of such recent aircraft as the "Javelin", D. H. 110, "Hunter", "Swift", Supermarine 508 and "Valiant" is a good effort in these days of restrictive security. Particularly well represented is the American industry, and the difficult Russian section is well handled and informative without indulging in wild guesses.

In the Russian section, Jane's cautiously mentions a number of "miscellaneous unidentified aircraft" which are known to exist but information on which is insufficient for positive identification. Among them is *a six-engined long-range bomber*, provisionally designated Type 31, with straight-jet or turboprop engines (cf. "Interavia Review" No. 3, 1952) ; it is said to have a crew of 11 plus a complete relief crew of 11 and to be capable of making the round trip from the U.S.S.R. to the U.S.A. and back non-stop. The *new Russian fighters* listed in the book include the MiG-15's all-weather version with more powerful engine plus auxiliary rockets, etc. ; the latest MiG-15 is reported to have a top speed of 670 m.p.h. and a rate of climb of 10,400 ft./min. MiG-15 production was estimated to have amounted to 450 aircraft a month in 1951. Jane's finally mentions a twin-jet medium bomber, a new amphibian and a new flying-boat and a large helicopter capable of carrying more than 40 passengers.

The World's engines are representatively illustrated and described, jets and pistons being separated as usual. It is particularly interesting to read, on page 266, the Editor's true explanation of the way the Russians were sold the 25 "Nene" and 30 "Derwent" engines at the insistence of the late Stafford Cripps in the teeth of Ministry and Rolls-Royce opposition. Powers and sizes of the later American jets are markedly characteristic of the big ways of their country. A photo of the 4,000 kg. Rateau SRA-101 axial-flow "Savoie" also is news.

There is, as always, only one way to close a review of Jane's. It is excellent value in the field of technical aviation reference literature.

"*The Observer's Book of Aircraft*". By William Green and Gerald Pollinger, with a foreword by Peter Masefield. Frederick Warne & Co., Ltd., 1-4 Bedford Court, Bedford Street, London, W.C.2. (English ; 254 pages ; 5s.)

After something of a post-war lapse, there is now a marked revival of interest in aircraft recognition in Great Britain, where the subject was brought to a fine art by the stern necessities of war in 1940 to 1944. For those who want a handy ready-reference this is an excellent pocket-size book which contains more for the money than any similar publication. The main aircraft types are shown by a photograph, silhouette and brief data, the less common aircraft by a picture and a lengthy caption. The types are grouped by characteristics, always a tricky point, but an alphabetical index makes reference easy. A concise note explains nomenclature and type numbering in Britain and America and there is a list of civil aircraft registrations. J. H. S.

"*Air Navigation Theory and Practice*". By E. Brook Williams & W. J. V. Branch. Sir Isaac Pitman & Sons, Ltd., Parker Street, Kingsway, London, W.C.2. (English ; 644 pages ; £2.15.0.)

This massive volume has been prepared as a general textbook with self-instruction in mind, and there are both worked examples and specimen questions wherever appropriate. In their preface, the authors give a guide to the would-be student and suggest standards of knowledge in the various aspects of navigation required by private pilots up to flight navigators and flight operations officers.

The book is logically built, starting with symbols and a chapter on the elementary mathematics of navigation ; this is followed by a longer chapter on trigonometry, both plane and spherical, leading to a discussion of the terrestrial sphere. Flight calculations, navigational instruments and map projections are the subjects for other chapters in what can be considered as the basic half of the book.

Radio and radar aids are described at some length, with particularly clear expositions of the working of GEE, Decca, Consol, V.H.F. Omni-Range and the rest. D.R. navigation is dealt with to the tune of eighty pages. This is followed by a long treatise on astro navigation, a shorter piece on the tides and a long one on magnetism. The book closes with a note on flight planning.

The author has dealt with his difficult subjects clearly and readably in the body of the text, supplemented by illustrations, photographs, sketches and diagrams, as well as graphs. J. H. S.

Rocket Propulsion. — By Eric Burgess. — Chapman & Hall, Ltd., London, 1952. (English, 235 pages, 21s.)

The author, assistant secretary of the British Interplanetary Society and widely known for his lectures on the problems of rocket propulsion, has set himself to produce a book midway between the highly scientific treatise which is difficult for the layman to follow and the popular scientific approach. He begins with the general principles of rocket propulsion and then deals successively with rocket fuels, motors, control of flight, long-range rockets, atomic propulsion.

Warning that some mathematical formulae have had to be included for the serious student, the author remarks however that the general reader can omit such passages without losing the continuity of the work. The text is illustrated by over 70 diagrams, tables, section drawings and photographs.

Rocket science will become more and more important in the years to come, and the present book can render useful services to the interested layman and to the expert who wishes to devote himself seriously to rocket research.

Sp.

Books received

Publications scientifiques et techniques du Ministère de l'Air. — Distributed by Service de documentation et d'information technique de l'Aéronautique, Paris :

No. 265. *Contribution à l'étude de la sursaturation du fer en hydrogène cathodique*, by Jean Duflot.

No. 267. *Application de la notion d'échauffement relatif à l'étude de la convection forcée de la chaleur*, by Edouard Roche.

No. 269. *Contribution à l'étude expérimentale des écoulements gazeux rapides par les méthodes de perturbation — Utilisation des ultrasons*, by Geneviève Dubois.

*

Mitteilungen aus dem Institut für Aerodynamik an der Eidg. Techn. Hochschule in Zürich. — Published by Prof. Dr. J. Ackeret.

No. 18. *Experiments on Aerodynamic Cooling*, by Lloyd F. Ryan. — *Untersuchungen an einem Gegenlaufpropeller im Windkanal*, by M. Degen. Verlag Leeman, Zurich.

*

27th Conference of the Chambers of Commerce of the Mediterranean and French Africa : *Les Problèmes de l'Aéronautique Marchande.*

Moderne Luchtstrijdkrachten, by Hugo Hooftman ; N.V. Uitgeverij "De Kern", Amsterdam-0.

*

Publications of the International Civil Aviation Organization. — Published by ICAO (in English, French and Spanish), Montreal.

Operation of Aircraft. — International Commercial Air Transport (Annex 6, 2nd Edition).

Aeronautical Telecommunications (Annex 10), Amendment No. 6 to the International Standards and Recommended Practices.

Communications Codes and Abbreviations, Amendment No. 1.

Search and Rescue (Annex 12).

Aeronautical Information Services Division. — Report of the First Session (Montreal, August-September 1952. Doc. 7323-AIS/502).

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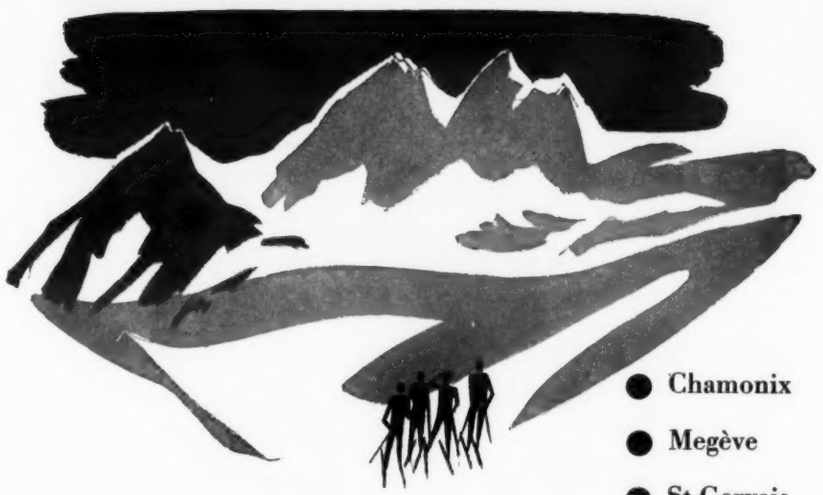

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